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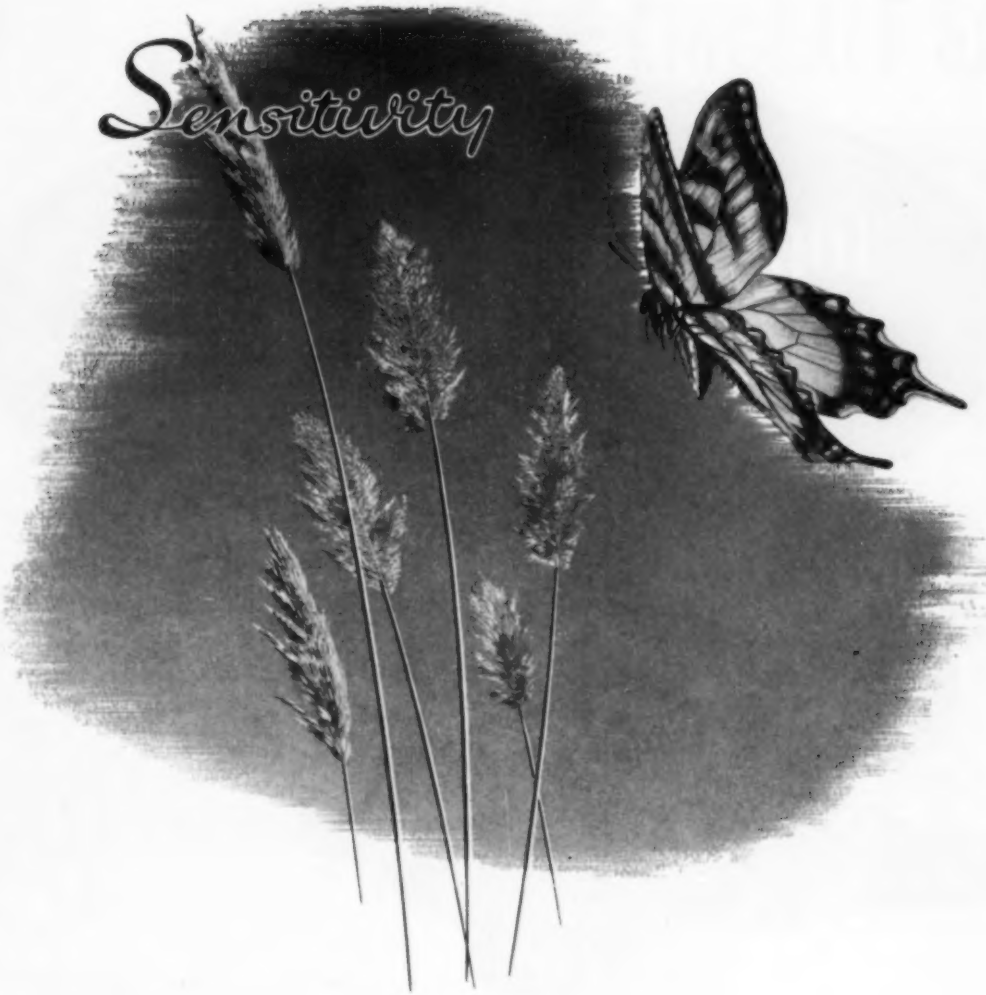

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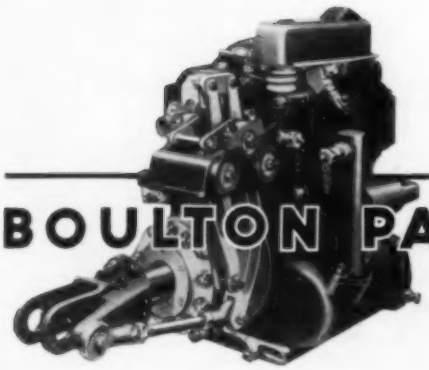

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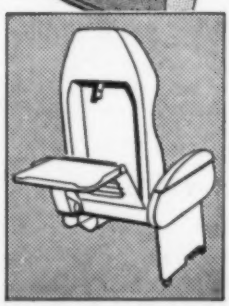

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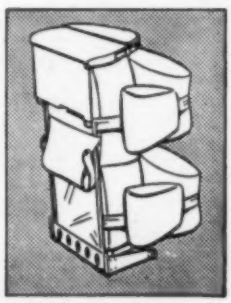

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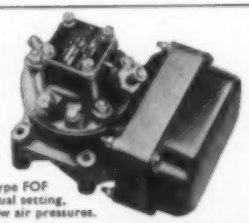
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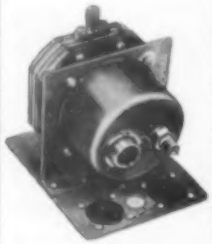
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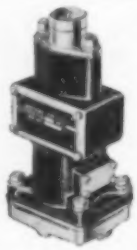
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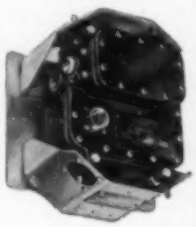
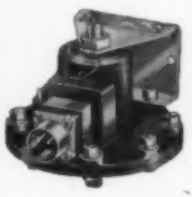

Type FLY Pressure ratio.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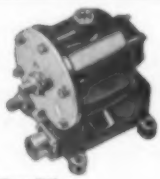
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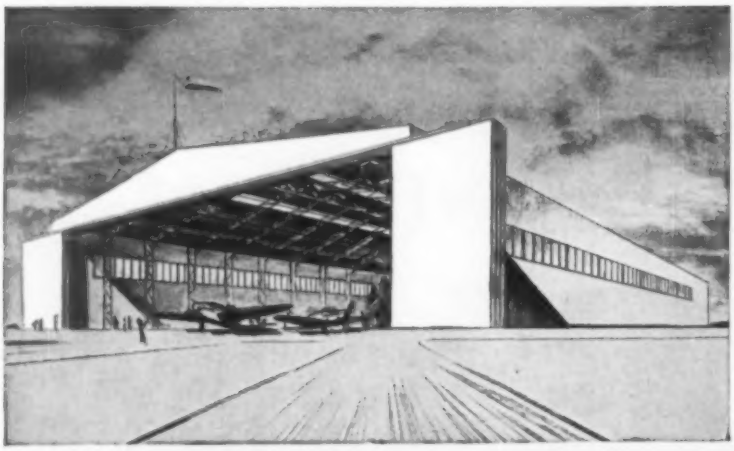

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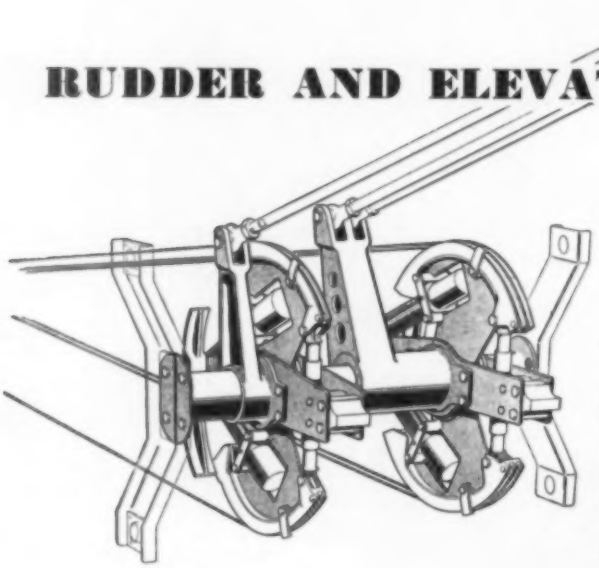

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THE ELEVATOR AND RUDDER CONTROL quadrants shown were designed for the Fokker "Friendship" turboprop transport. At first sight they appear to be normal cable driven quadrants, but the cylinders contain a most ingenious mechanism. This mechanism automatically establishes the tension in the cables, and holds it constant at all altitudes and flight conditions, therefore friction remains constant —an important contribution to stability, especially during auto-pilot or I.L.S. conditions.

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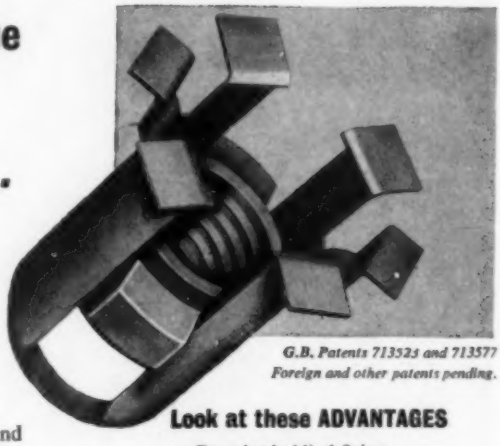

G.B. Patents 713525 and 713577 Foreign and other patents pending.

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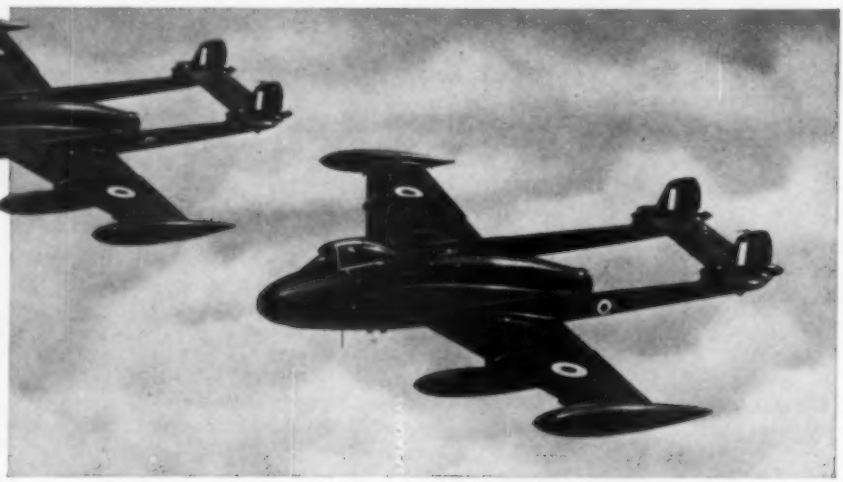

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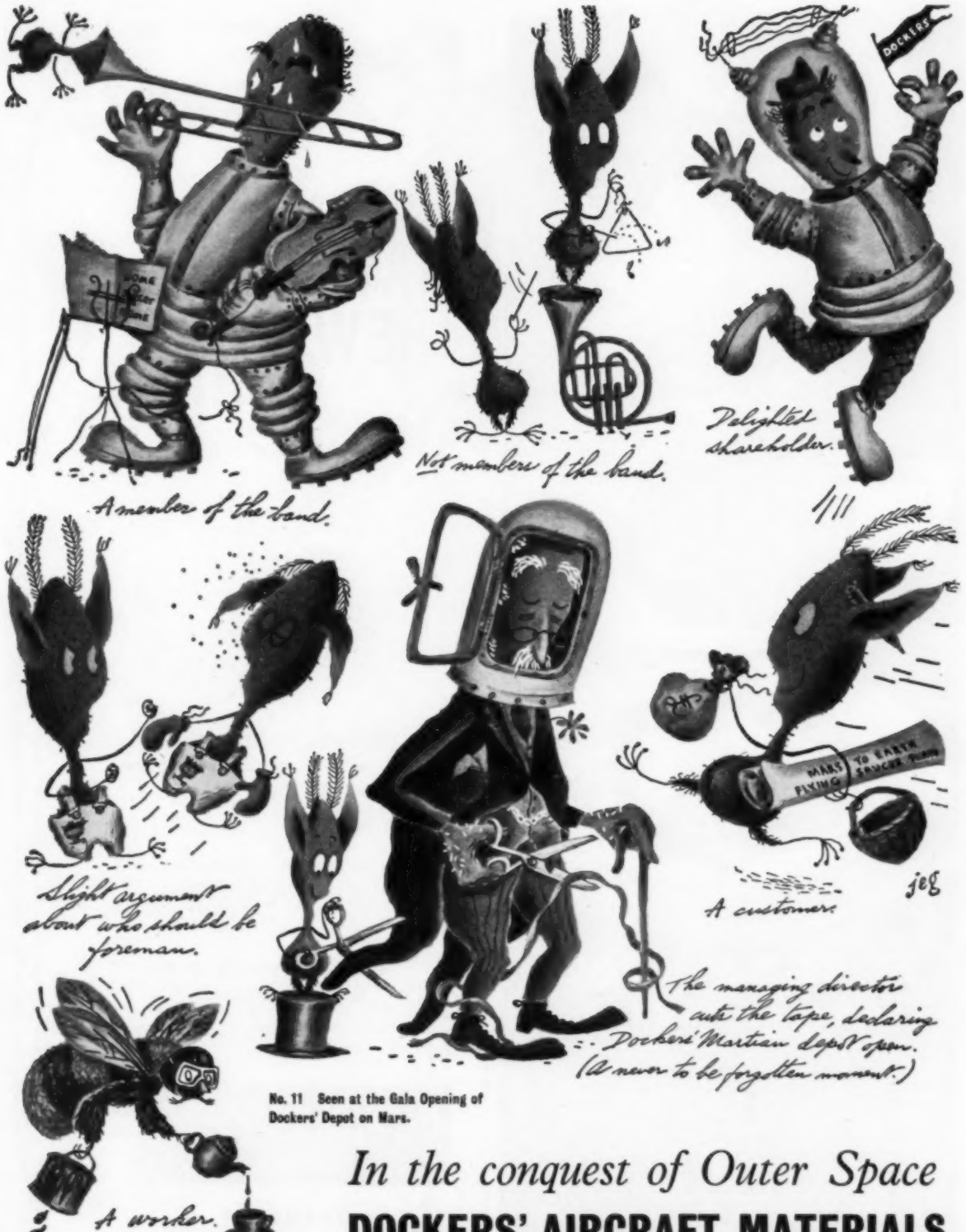

No. 11 Seen at the Gala Opening of Dockers' Depot on Mars.

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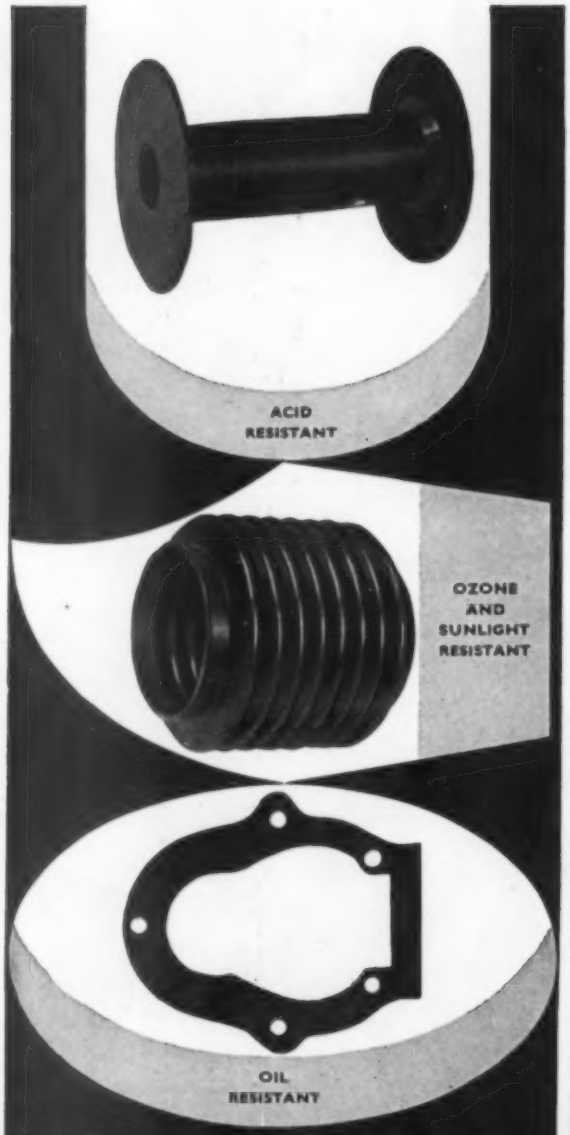

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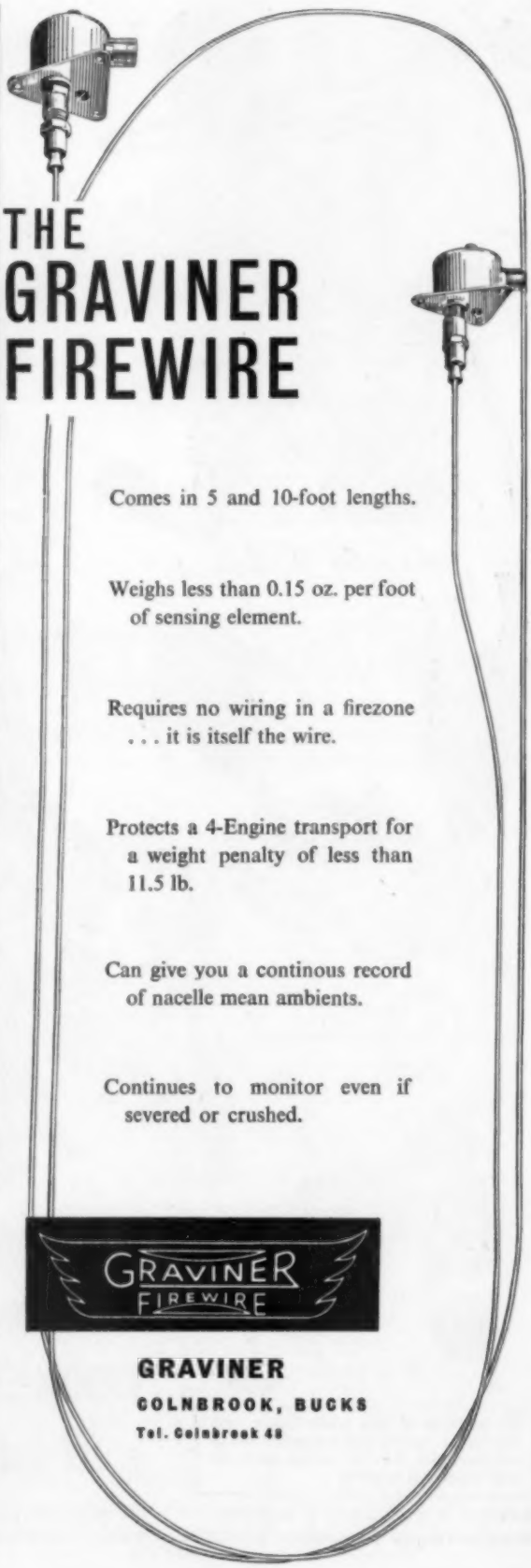

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FLIGHT and AIRCRAFT ENGINEER

No 2491 Vol 70 FRIDAY 19 OCTOBER 1956

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Mach Number a Back Number?

SMARTLY contemporary as our title may appear, we must confess to having grafted it from an editorial now ten years old. The term Mach number, we observed at the time, had been on everybody's lips for a year or two when along came Mr. R. Smelt with a lecture and largely debunked it by declaring that it was of little significance. Mr. Smelt had disclosed that the benefit of sweep-back in delaying shock-stall had been foreseen in Germany before the war, but that no one in this country had appreciated its importance.

At the time, it is true, the speed record stood to our own credit, and the superiority of our fighters was everywhere acknowledged. But thenceforth the story was that of our resting, in penurious indolence, on the Meteor's laurels, while the Americans cut their way forward with the Germanic Sabre, clearing the way beyond Mach 1 and striking the decisive blow in Korea.

We threw down no challenge to the Sabre until, with a brief and splendid resurgence, Hawker and Supermarine successively retrieved the record. Then back across the Atlantic it returned, to rest secure until Peter Twiss, in Fairey's F.D.2, won it with his resounding 1,132 m.p.h.

But though records, by definition, are observed performances, it does not follow that every achievement is a matter of record; and if the Americans claim that their F-104 has flown in the high Mach 2s, we must give them heed, if not blind credence. We can at least be sure, from page 632 of this issue, that before its recent accident their Bell X-2 had flown faster than any man-carrying vehicle—perhaps at 2,200 m.p.h. From the same page we learn that the projected X-15 may exceed 4,000 m.p.h. and that a missile has already attained Mach 10.4.

We may suppose that by "Mach number" our ten-year-old leader implied "Mach 1"; so the term is now even more of a back number than the issue of *Flight* containing it. Not so the deathless dictum which opens H. G. Wells' *The War In The Air* (published 1908):— "This here Progress," said Mr. Tom Smallways, "it keeps on. You'ld hardly think it *could* keep on. . . ."

The Living-Room Look

"THE trouble with tourist-class cabin layouts," somebody once said, "is how to make them more uncomfortable than first-class." For years people had been trying to make the final cynical comment on modern airliner accommodation—and that was it.

Uncomfortable, to be just, was perhaps too strong a word: uninspired might have been more appropriate. But it was not altogether unfair. We know of a good many first-class services on which one fifth of the passengers are required to sit in the middle of that social solecism, the triple chair. Tourist travellers will, as a rule, submit to such sardinery—but not those who pay first-class fares.

Since tourist traffic now accounts for about 40 per cent of the world total (it is, of course, gaining steadily), the problem today is how to differentiate between first-class and tourist-class standards of comfort. The margin between the two types of layout is narrowing. (Should anyone doubt this, let him travel tourist by PanAm DC-7C.) If first-class traffic and the rich revenue therefrom is still to be attracted, a radically new approach to the airliner's cabin may have to be made.

For a start, we suggest, throw away the tramcar-seating, the hat-racks, and everything that contributes to the "tube-look." Next, a leaf might be taken out of American Airlines' furnishings book. Their new and original treatment of the Lockheed Electra's interior (first revealed at the recent I.A.T.A. conference, and illustrated on page 633 of this issue) is something that airline sales departments have been wanting to do for years—but dared not for fear of the revenue-conscious accounts department.

We shall see more and more of "the living-room look" in the future. And although the airlines may turn to specialist design consultants for ideas, the manufacturers might well breathe new life into their furnishings D.O.s (as Bristol have just done) in readiness for this new, inevitable, and most welcome trend.

FROM ALL QUARTERS

Valiant's Atomic Initiation

ON Thursday, October 11, the first British nuclear weapon to be dropped from an aircraft was released by an R.A.F. Valiant over Maralinga, South Australia, as part of "Operation Buffalo." A small bomb, as such weapons go, it was equivalent in explosive power to 10,000 tons of dynamite, and was detonated only a few seconds after it had been released from the aircraft.

The height of the explosion—the actual has not been revealed—played strange acoustic tricks. People at Kingoonya, 200 miles away, heard a "thunderous double explosion," but others living less than 100 miles from Maralinga heard nothing.

The Valiant's bomb-aimer, F/L. E. Stacey, set his sights on a target ploughed out by bulldozers in the grey-green desert foliage. His aiming was afterwards described as "bang on." Other members of the crew of the aircraft, which was from No. 49 Squadron, Wittering, were S/L. E. J. G. Flavell, captain; F/L. J. A. Ledger, co-pilot; F/L. G. B. Spencer, navigator and plotter; and F/O. G. W. Ford, air electronics officer.

Ocean Search for U.S.A.F. Transport

ONE of the biggest air-sea rescue searches ever conducted from this country was made over the Atlantic last week for survivors from the U.S.A.F. Liftmaster (C-118) which disappeared after taking off from Lakenheath, Suffolk, on October 10 for the Azores. At one time 92 aircraft were taking part—including six from Iceland and six from Malta—and the U.S. Navy sent an aircraft carrier and six destroyers.

The Liftmaster, with 50 American servicemen and a crew of nine aboard, was due to land at Lajes, in the Azores, at 12.26 a.m. on October 11 and had fuel to last until 5.30 a.m. The last signal from it was a routine "on course" message received by Shannon at 8.36 p.m. on October 10.

On October 15 a partly deflated dinghy (first sighted by a Shackleton) and two wheels with part of an undercarriage, were picked up off the N.W. coast of Spain by the British tanker *Navicella*.

Faster and Higher

FROM across the Atlantic news has been flowing of remarkable achievements in speed and altitude and of the design performance of future vehicles.

A recent announcement by Mr. Donald Quarles, Secretary of the U.S.A.F., revealed that records extracted from the instrumentation of the crashed Bell X-2 research aircraft (the accident was reported in our issue of October 5) showed that shortly before its destruction the machine had been flying faster than had any other man-carrying vehicle. The pilot, who was killed, was Capt. Milburn G. Apt, and his probable speed was in the region of 2,200 m.p.h. The same aircraft had previously flown to over 126,000ft.

More than three times the X-2's speed, namely 6,864 m.p.h., was recorded by a research missile launched by the N.A.C.A. from their research station at Wallop's Island, Virginia, in recent weeks. It has just been announced that the vehicle was powered by four rocket motors fired in series, the first two being Nike-type boosters. The trajectory attained a height in excess of 200 miles; and the speed reached, equivalent to rather more than Mach 10.4, is greater than any previously announced for such a test firing. The vehicle was fully instrumented and was investigating problems involved in the design of manned vehicles for speeds of more than 3,000 m.p.h. Mr. Floyd Thompson, associate director of research at the N.A.C.A. Langley laboratory, said that such flight appeared "within the realm of relatively early attainment."

Further details have also been released regarding the North American X-15 research aircraft which is being jointly developed with the N.A.C.A., the U.S.A.F. and the Navy. For the current fiscal year the U.S.A.F. requested £6.7m for the X-15 programme but was only allowed £2.8m. The first X-15, which should be ready in about two years, is expected to reach an altitude well above 200,000ft (a ceiling of 100 miles was originally mentioned) and will probably have a control system consisting of small rocket nozzles to effect changes in direction outside the atmosphere. The design speed is reported to exceed 4,000 m.p.h.

Finally, it is reported that Lt-Cdrs. Malcolm Ross and Morton Lewis of the U.S. Navy intend to exceed the world absolute height record of 72,395ft, established 21 years ago by Capts. Anderson and Stevens of the U.S. Army Air Corps with a helium-filled balloon. The Navy scientists have already taken a plastic balloon with an open gondola to 40,000ft and are now reported to be aiming at 80,000ft or more in a pressurized gondola, and to stay at that height for about eight to ten hours and collect aero-medical and geophysical information.

Fairey's New Chairman

FOLLOWING the death of Sir Richard Fairey on September 30, the Board of the Fairey Aviation Co. announces the appointment as chairman of Mr. R. T. Outen, the deputy chairman.

Mr. Roland Thomas Outen joined the Board in January 1943. On October 29, 1949, he was appointed deputy chairman of the company and thus for the last seven years has worked in the closest collaboration with Sir Richard.

Mr. Outen is senior partner in the City law firm of Ashurst, Morris, Crisp and Co., and has specialized in company and commercial work. He is the chairman of International Harvester Co. of Great Britain and also of Quaker Oats, Ltd., and deputy chairman of Smith and Nephew Associated Companies, Ltd. He is a director of Ashanti Goldfields Corporation and other firms.

Mr. Outen.

Back to the Antarctic

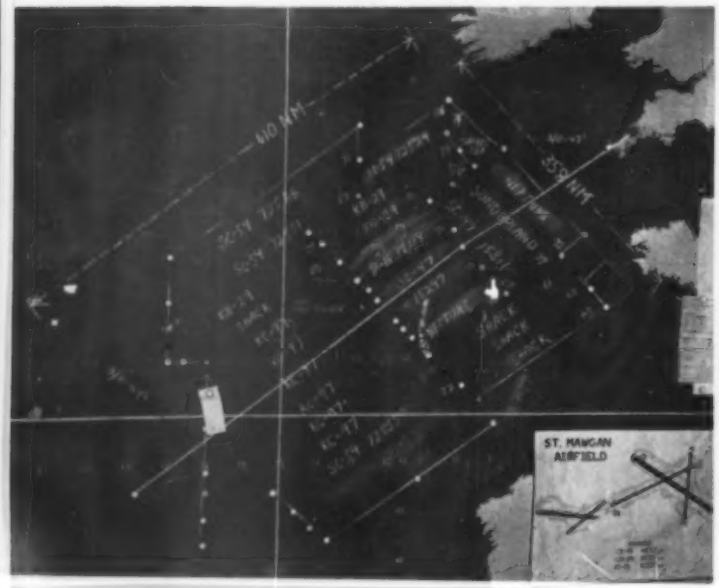
THE main party of the Hunting Aerosurveys expedition to the Grahamland Peninsula of the Antarctic continent is due to leave Harwich today, October 19, in their base ship *Oluf Sven*, for their Deception Island headquarters. The purpose of the expedition (undertaken on behalf of the Governor of the Falkland Island Dependencies) is to photograph some 50,000 square miles of British territory.

This will be the expedition's second season on this work. The two Canso amphibians, which left Toronto last month, are due in at Deception early in December, after carrying out an aerial photographic survey in the Falkland Islands themselves during October and November.

The *Oluf Sven*, which arrives a few days before the amphibians at Deception Island, will again act as a heli-carrier, or mother-ship to the Bell-47G helicopter (owned by Autair) used to carry the surveyors. This time a deck lift has been fitted, so that the Bell can be housed in the hold completely assembled. Radio communications are to be operated by International Aeradio, and the expedition will leave Deception Island next March and be back in Britain in May.

Westminster, Wessex, Whirlwind, Widgeon

PRELIMINARY work on the massive Westminster helicopter has made good progress during the past year. This is disclosed in the chairman's statement, released in advance of the annual report and accounts of Westland Aircraft, Ltd. With its carrying capacity of five tons, or 40 passengers, this important project is "being tackled with every proper precaution." Actual construction



THE GREAT SEARCH for the missing U.S.A.F. C-118 (see news item above) is epitomized by this picture of the chart at R.A.F. station St. Mawgan, Cornwall, showing positions of the aircraft engaged.

***ALIZE** is the name of this new Bréguet 1050 anti-submarine aircraft, powered with a Rolls-Royce Dart turboprop. (See news item on p. 643.)*

of the first flight-prototype, which will be a simplified "crane," is in hand, and the chairman reported that he was able to foresee the allocation of sufficient resources definitely to complete the project to this stage. With the exception of the Eland gas turbines, which are being supplied on loan by Napiers, the Westminster will have been entirely financed by the company. The problem of silencing is already occupying the company's attention.

The chairman also remarked that the Wessex (one Napier Gazelle) will find "other Service applications" in addition to meeting the Navy's requirements for anti-submarine duties. Later it will be made available to civil operators as a fourteen-seater. Whilst the Ministry of Supply has placed a development order for this aircraft, Westlands have agreed to make a considerable contribution towards the cost. The Whirlwind continues in full production; the Widgeon is now available with full C. of A.; and the Dragonfly production run is practically at an end.

Reference to a new Westland share issue is made on page 656.

Mr. G. D. Duguid

A MEMORIAL service for Mr. G. D. Duguid, M.A. (Cantab), M.I.Mech.E., M.I.M.I., A.I.B.A.E., late Principal of the College of Aeronautical and Automobile Engineering, Chelsea, was held last week at the Chelsea Parish Church of St. Luke. Mr. Duguid died on September 30.

After demobilization from the Royal Artillery in the First World War, Mr. Duguid went into residence at Christ's College and read mathematical science at the University School of Engineering. He joined the research department of the London General Omnibus Company, and in 1925 became a member of the staff of the College of Aeronautical and Automobile Engineering.

Air League at the Mansion House

THE Lord Mayor of London, Sir Cuthbert Ackroyd, presided at the luncheon given by the Air League of the British Empire at the Mansion House last Thursday, October 11. The Egyptian Room was filled to capacity, but the traditional formalities treasured by many guests at luncheons and dinners at the Mansion House were not all observed in the customary manner.

After the toast of the Lord Mayor and Corporation had been proposed by Air Chief Marshal Sir George Pirie, chairman of the Air League, the Earl of Swinton (who was Air Minister in 1935-38 and Minister of Civil Aviation in 1944-45) rose to make the principal speech. This usually takes the form, year by year, of a discussion of affairs with which the Air League is particularly concerned.

One of these, said Lord Swinton, was the question of how much the country could afford to spend on defence. Because there was a limit, it was important that what could be afforded should be spent in the right way. Nothing could be worse than "the three Services, with a Ministry of Supply somewhere in the rear, lining up in a food queue and each of them getting a completely inadequate ration." Defence policy must be viewed as a whole. Decisions should cover the whole field, and they should be taken on the highest common factor of efficiency rather than on the lowest common denominator of compromise, which was always the easy way out. "I am sure that we shall only get that proper policy," continued Lord Swinton, "if we have a single Minister responsible for both policy and action; in other words, an effective Minister of Defence."

In peace it was no less necessary to have such a single Minister. It was axiomatic that the best preparation for war, and therefore the best insurance for peace, was readiness; this meant maintaining in peace-time an organization which would need least change and improvization for war. The maximum of co-operation in the Services at all levels was less easy to achieve in peace than in war, and therefore there was the need for a Minister of Defence with real and effective power over all the Services.

Turning to the question of delays in Service aircraft deliveries, Lord Swinton said: "I cannot resist the conclusion that the ordering of Service aircraft should revert to the Air Ministry. All my experience in the war reinforces this. . . . We would never have got the aircraft—after all, we were ordering new types—if the Air Ministry had indented on some Ministries, or even shared the responsibility. The secret of the success we had was that always, all the time, we were working with the makers of the airframes and the engines, and I do not mean only in research and production."

Of transport aircraft for the R.A.F., the speaker said that at all stages the closest co-operation was needed between the Air Ministry, the Royal Air Force and the civil users—"We want co-operation, and I think there ought to be a good deal of 'give' on behalf of the Air Force. Civil operators have got to have aircraft which can compete and get an increasing share in the air transport. With goodwill and mutual understanding, I feel, the Air Force could make more use of civil types with the minimum of modifications."

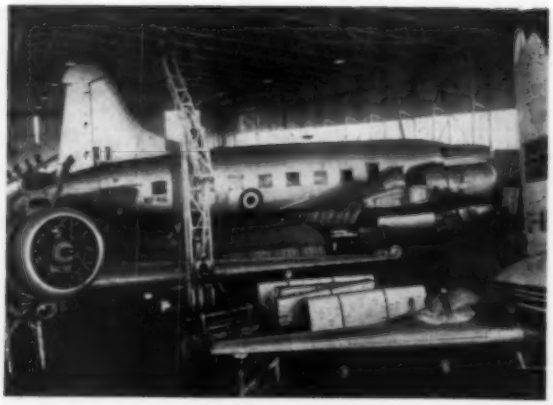
This led Lord Swinton to the subject of air trooping. If civil operators bought new and costly machines for trooping, they must have a reasonable certainty that they would be able to write off or amortize those aircraft during a reasonable time; they could not gain that security on short-term or hand-to-mouth contracts.

The final subject reviewed by the speaker was that of the national air corporations. They should have the best aircraft wherever they could find them, but it was the hope and intention that those aircraft should be British if possible. This meant continuous co-operation between British airlines and the British aircraft industry.

Concluding his address, Lord Swinton said: "It is rather a disturbing thought to me that, after the Britannia, I do not know whether there is a long-range British liner in sight or even in the offing. I will leave you with this thought: this, perhaps, is a problem on which B.O.A.C. and the aircraft industry and the Government might well more concentrate."

Closing speaker was Sir Frederick Handley Page, who congratulated Lord Swinton on the manner in which he had explained his views. It was not clear whether Sir Frederick agreed with them.

***THE LIVING-ROOM LOOK** of the Lockheed Electra is shown in the sketch below and the photograph of a mock-up on the right. Comment on this engaging interior is made in a leading article in this issue.*



Flying in the Varsity Converted by Eagle Aircraft for Royal Duty in Jordan

FITTED FOR A KING

The royal compartment, looking forward (above) and aft. Note the telephone, with radio set immediately beneath it; the royal monogram on the seat covers and above the small instrument panel; the fluorescent lighting; and the fan at each end of the compartment.

AT 8,000ft and well above a solid white mass of strato-cumulus overlaying Hampshire, we relaxed luxuriously in the elegant royal compartment of the Vickers Varsity converted for the use of King Hussein of Jordan by Eagle Aircraft Services, Ltd., reflecting that there is much to be said for being a king—especially when it enables one to purchase the aircraft of one's choice, and have it modified according to personal requirements.

The seat was wide and softly upholstered; a table gave comfortable provision for meals or magazines; immediately overhead were light and ventilation controls and a service bell; the windows, tastefully curtained, and augmented by an observation window set into the main door, afforded an excellent view; a push-button radio within arm's-length supplied alternately Mrs. Dale's (medium-wave) Diary or, perhaps more appropriately, short-wave Arabic dance-music; above it was a maroon telephone, for royal communication with the captain of the aircraft; opposite, on the bulkhead by the cabin door, a triangular panel accommodated an electric clock, an altimeter and an air-temperature gauge, the three instruments being surmounted by a small gilt crown. The regal emblem was also displayed on the seat covers, and the whole compartment—twin facing seats, plus two full-length couches—was appropriately finished in royal blue and pale grey. And while the Hercules 264s, with red spinners and their airscrew blades tipped in red, white and green, gave a confident, happy sound at cruising revs, it was possible to talk comfortably in ordinary tones.

At the rear of the royal compartment is the powder room designed for Queen Dina's use, with an extremely neat dressing-table installation, a full-length mirror, fluorescent lighting and both hot and cold water taps on the wash-bowl. (The inclusion of hot running water on this extra-special Varsity, for the kitchen as well as the wash-bowls, is a particularly ingenious feature of the conversion. A 40-gallon tank has been put where the bomb bay used to be, and the water is pumped up and electrically heated immediately, as soon as the hot tap is pressed.)

But it is when one goes forward from the royal compartment that one realizes just how remarkable this transformation of an R.A.F. "flying classroom" has been, and how radically altered in a Blackbushe hangar the somewhat drab, utilitarian Varsity T.1 WF 416 which has now emerged as the handsome silver-white Jordan V.V.I.P. transport VK 501.

Where previously there was a mass of navigation, radio and bomb-aiming equipment, there is now a smart, compact kitchen with enough mod con to rejoice the hearts of housewives from Macclesfield to Maida Vale; beyond that there is a compartment for the royal entourage; and at the front of the aircraft the original cockpit has been considerably redesigned to transform it into a transport flight deck.

Kitchen equipment includes a refrigerator, a water heater for hot drinks, special storage for soft drinks, and a hot-food container. Crockery (which includes a specially-made 187-piece dinner set) and a canteen of cutlery have been supplied for use in the aircraft.

The front compartment, which seats nine (six facing towards the tail and three forward), is furnished up to first-class airline standards, though the seats are of the non-adjustable type. Lighting and ventilation are as comprehensive as they are in the royal compartment, with individually adjustable punkah louvres above each seat and extractor ducts in the roof; similarly, there is a fan on the bulkhead and the "No smoking" and "Fasten your seat belt" signs which light up are worded in Arabic. There is also in the aircraft a floor-level heating system for operation in cooler climates. Usefully, too, in the front compartment, access is possible during flight to a baggage-hold just below the floor.

There has been considerable redesigning of the original cockpit

The Varsity before and after its conversion. At left, facing, are seen early stages of the work, shortly after its arrival as a Service aircraft — WF 416—at Blackbushe. On the right it is seen in its new white-and-silver colours, lettered in English and Arabic, and bearing the royal crest.

to transform it into a flight deck, with separate positions for navigator and radio operator in addition to the captain's and first officer's seats. This has involved the repositioning of major items such as batteries, hydraulic tank and drift sight adjustment. The bomb-aimer's view blister has been removed, and crew access to the flight deck provided through what was the original cockpit floor.

All the former radio equipment and cabling has been removed. In its place, two 140-channel V.H.F. transmitter/receivers and a radio compass in duplicate have been installed, in addition to a medium and short wave communication receiver. I.L.S. equipment consists of localizer and glide-path receiver with three-lamp marker indicator. A hundred-channel pretuned M.F./H.F. transmitter/receiver is also fitted, plus intercommunication between all crew members and between the royal compartment and the captain.

Flying the Varsity on this occasion was Captain J. H. W. Grobler, an officer seconded from the R.A.F. to the Royal Jordanian Air Force at Amman for instructional duties, and whose immediate task it was to carry out the acceptance checks on VK 501 and take it out to Jordan. With him as co-pilot was Capt. Z. Hamzeh, who is in command of the R.J.A.F. transport squadron at Amman and will captain the Varsity on its royal journeys.

It was while Capt. Hamzeh was taking a rest during this 2¼ hr fuel-consumption test that we had an opportunity of seeing how the royal Varsity flies.

One's chief impression was of its steadiness and good temper as a regal chariot. At +2 lb boost and 2,000 r.p.m., we were getting along comfortably at 165 kt, with nine people aboard. (Approximately 5 kt extra has been gained by removing the under-fuselage bulge which formerly accommodated the bomb-aimer and his pupil and replacing it with a new skin, thus smoothing off the underside of the aircraft.) When the starboard engine was throttled back and the airscrew feathered, there was no noticeable yaw: Capt. Hamzeh, at that time sitting in the back, said later he had noticed nothing. Thus the Varsity's asymmetric stability is a useful tribute to its royal airworthiness; and at +2 lb boost and 2,200 r.p.m. on the live engine we maintained height happily at 130 kt. The stall is a gentle affair, and does not occur with wheels down and 47 deg flap, at 0 boost and 2,400 r.p.m., until just over 50 kt—a speed unlikely to be reached in most normal circumstances. The Varsity is light on the controls and, for a big aircraft, very manœuvrable. Addition of I.L.S. and the convenient-to-hand twin-dial V.H.F.—already mentioned—are great advantages. Apart from these the cockpit layout is much the same as that of a normal Varsity; but now, on a flight deck just behind the pilots, the radio operator and navigator sit in workmanlike proximity.

Eagle Aircraft Services, Ltd., received Varsity WF 416 from the R.A.F. in March; they were given final specifications for its conversion in June: so, in all, the complicated work has taken approximately six months. The cost of the Varsity has not been officially stated, but one of "around £80,000" has been unofficially mentioned. Eagle Aircraft state that the following British companies have supplied "accessories and assistance" for the conversion programme:— Bristol Aero-Engines, Ltd.; Delaney Gallay, Ltd.; Docker Brothers; the General Electric Company, Ltd.; Marconi's Wireless Telegraph Co., Ltd.; Modern Telephones, Ltd.; Negretti and Zambra, Ltd.; Pye, Ltd.; Smiths Aircraft Instruments, Ltd.; Standard Telephones and Cables, Ltd.; Ultra Electric, Ltd.; and Vickers-Armstrongs (Aircraft), Ltd. Eagle Aircraft also acknowledge "valuable assistance" from the Air Ministry and the Ministry of Supply.

Capt. Grobler was due to fly the Varsity out to Jordan this week, leaving Blackbushe on Thursday if all went according to plan. At Amman this handsome aircraft, the Royal arms emblazoned on its side, was to join the R.J.A.F. transport squadron and to be used as personal transport for King Hussein and members of his family. They should find it an admirably reliable and comfortable means of communication. H. W.

AUSTRALIAN INDUSTRY S O S

SPEAKING at the annual federal conference of the Australian Air Force Association in Sydney recently, Air Marshals Sir Richard Williams and Sir George Jones said that "the Australian aircraft industry would disappear" if further orders were not placed now that the Canberra and Avon Sabre contracts were almost completed. A mission had visited the United States two years ago to assess various aircraft, but no decision had resulted.

G/C. J. L. Waddy, president of the New South Wales Division of the Association, said that unless action was taken immediately to preserve the aircraft industry, Australia would be back in the position it was in when World War 2 broke out.

DUTIES OF BOSCOMBE DOWN

THE organization and some of the problems of test-flying at the Aeroplane and Armament Experimental Establishment, Boscombe Down, were described in a lecture before the Graduates and Students' Section of the Royal Aeronautical Society on October 10. The speaker was S/L. P. D. Thorne, who was senior test pilot, "A" Squadron, at Boscombe before moving to the Operational Requirements Section of the Air Ministry last year.

The technical divisions at A. and A.E.E., S/L. Thorne pointed out, came under the headings of performance and handling; engineering; radio, radar and navigation; armament; and "airborne experimental." Of the four squadrons, A, B and C dealt respectively with fighters, bombers and naval aircraft, while Squadron D was concerned with "airborne experimental" and helicopters. There were, in addition, the Armament Test Research Section and the Civilian Aircraft Test Section.

Throughout the flight-test programme, the lecturer continued, pilots and technicians would work together as teams on the investigation of general and specific aspects of the performance of an aircraft and its equipment. The technician would guide the programme; the pilot would contribute his background knowledge of Service requirements. The purpose throughout was to examine the aircraft as an integrated weapons system.

Describing the test programmes of the various divisions, S/L. Thorne emphasized that Engineering was now of equal importance to Performance and Handling, in view of the many complicated systems which were essential in the modern military aircraft. For performance testing, much of which was delegated to approved firms, accurate flying of a high order was required, while the handling programme was "definitely the sort of flying that sorts out the men from the boys." Aircraft undergoing handling tests must be fully instrumented for the work; instrumentation did not replace the pilot's observation, however, it merely augmented it.

The final section of S/L. Thorne's lecture was devoted to a comprehensive (and amusing) summary of the main factors involved in transonic and supersonic test-flying. There were fewer basic handling problems on modern aircraft at these high speeds, he said; among the remaining difficulties, however, were those of navigation and of finding suitable test areas (in view of the complication caused by supersonic bangs).

"FLIGHT" PHOTOGRAPHS

MANY of the photographs reproduced in *Flight*, i.e., those taken by our own photographic staff (as indicated on publication) are subsequently available in the form of high-quality prints. Prices are as follows (dimensions given in inches): 5½ × 3½, 1s 4d (glossy or semi-matt, unmounted), or 2s (toned sepia, unmounted); 6 × 4, 2s 6d or 4s; 8 × 6, 3s 6d or 5s 6d; 10 × 8, 5s or 7s 10d; 12 × 10, 6s or 9s 8d; 15 × 12, 9s 6d or 13s; 20 × 16 (semi-matt only), 13s or 18s.

Also available are a postcard series, totalling over 200, depicting both historic and modern aircraft of the R.F.C., R.N.A.S., R.A.F. and F.A.A. A list of this card series is obtainable on application. Prices are 8d each card (7½d each for 12 or more)

EXOTIC SPECIMENS, worthy of any aquarium, are these two. Left, the new RP-70 Radioplane rocket-powered drone, for weapon system (missile) evaluation and training. Principal materials are steel and plastics; flight endurance is 8-10 minutes, ceiling 50,000ft, Mach number 0.9, length 9ft, and weight 300 lb. Right, the latest Aerocar, made at Longview, Washington, during "a test flight for final airworthiness certificate."

HERE AND THERE

Half Century

TODAY (Friday, October 19) the Royal Dutch Aero Club celebrates its 50th anniversary.

Bell Studies Decca

THE Decca navigation system is to be installed by the Bell Aircraft Corporation at its Fort Worth helicopter division. It is proposed to study the efficiency of the equipment in helicopter operations and to evaluate certain "special instruments" developed by Bell.

Australian Closure

AS the project on which it was working has been suspended, a Vickers-Armstrongs guided missile division at Salisbury, near Adelaide, South Australia, is to close down within six months. Those of the 100 workers who are British are being offered repatriation and employment with Vickers-Armstrongs in the U.K.

U.S.A.F. Order F-104s

REPEAT contracts totalling £60m have been placed by the U.S. Air Force with the Lockheed Aircraft Corporation for F-104 Starfighters. One contract is for £40m worth of 104As and the remainder of the order is for two-seat 104Bs. Lockheed have also received a "letter contract" authorizing tooling, materials and equipment for quantity production of the RF-104A (photo-reconnaissance) Starfighter.

T.V. Publicity

A FILM made by the Central Office of Information to publicize the products of the British aircraft industry and to help in promoting its exports has been sent to the United States and is now being shown by about 150 television stations there. Lasting approximately fifteen minutes, it includes interviews with Mr. Edward Bowyer, director of the Society of British aircraft constructors, and Mr. Peter Masefield, managing director of Bristol Aircraft, Ltd.

Skyhawk Joins the Fleet

SMALLEST combat jet aircraft in America, the Douglas A4D Skyhawk is now in service with the U.S. Navy. Following "fleet indoctrination program" trials at Quonset Point—during which the machine set a new record for low maintenance time and high availability—production Skyhawks are with both the Atlantic and Pacific fleets. Douglas (El Segundo) have thus received clearance for delivery to the U.S. Navy of three combat types in 1956, the previous models being the A3D Skywarrior and the F4D Skyray.

Philatelic Flights

NEW designs for Chilean air-mail stamps include representations of a Venom (on the $1 purple and $20 blue designs) and what appears to be a Viscount (though only part of the aircraft is depicted) on the violet $5 stamp.

The Last Beard

FOR many years the only R.A.F. officer with a beard, G/C. V. Gaskell-Blackburn died recently at his home at Waterville, County Kerry. He began his service in the Royal Navy and, on transferring to the R.A.F., obtained special permission to retain his beard. He retired in 1947.

Northrop-Vertol Tie-up?

FROM New York it is reported that the Northrop Aircraft company has proposed a merger with the Vertol Aircraft corporation, the Pennsylvania helicopter firm originally known as Piasecki. Northrop are stated to have offered two Northrop shares for each share of Vertol common stock held by the latter concern's shareholders. Both companies are considering the proposal.

Not Interested

A REPORT from Washington says that when Mr. Charles Wilson, the U.S. Defence Secretary, was asked at a Press conference whether he would permit an American aircraft to challenge the Fairey F.D.2's record of 1,132 m.p.h., he replied: "I am not really interested in that kind of competition one way or the other. We are interested in developing superior planes . . . and I don't think it matters very much what the so-called official record is."

Japanese Aircraft Production

A PRODUCTION plan for constructing 1,340 military aircraft next year is being drafted by the Japanese Defence Board.

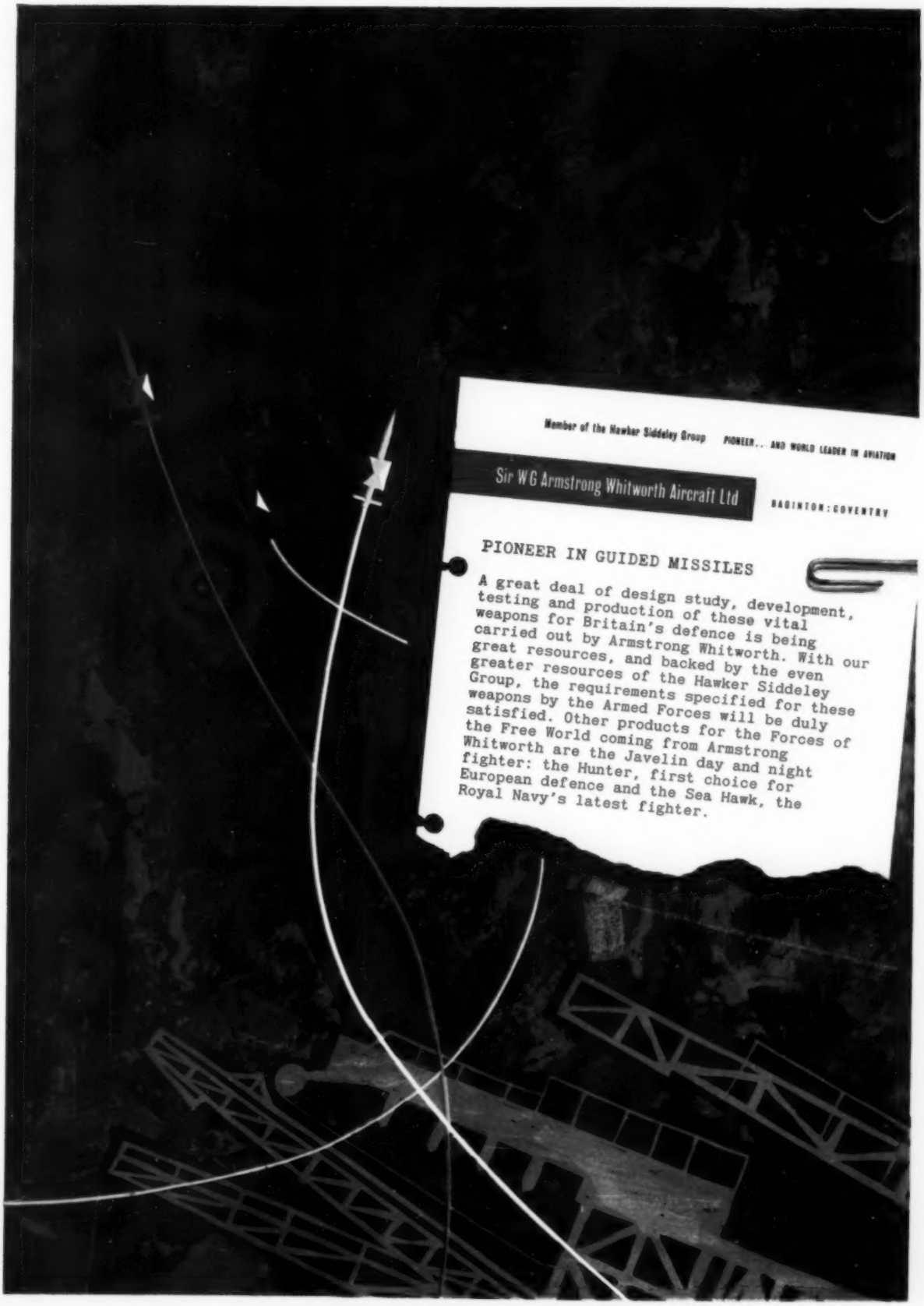
Road Test Anthology

PERFORMANCE tests of 33 different types of car are included in "*The Autocar* Road Tests of 1956 Cars," reprinted from *The Autocar* and published for our associated journal by Iliffe and Sons, Ltd., at 7s 6d net (postage 10d). The new edition covers cars from the Austin A30 Countryman to the Bentley Series S saloon and includes British, American, French and German makes.

Sprayed Out

A PLAGUE of flies at Mansfield Woodhouse, Notts, sewage disposal works was destroyed by spraying from a Hiller 360 operated by Fison-Airwork, Ltd. The helicopter made two runs at an altitude of six feet spraying a preparation known as Midox Red, which it was hoped would kill the flies without harming certain bacteria essential to the sewerage treatment process. A check made four weeks later showed that the pest had been eliminated.

DEMONSTRATOR: Making its first appearance in North America, before the R.C.A.F., U.S.A.F. and U.S. Navy, is the Jet Provost trainer. Seen in Canada are the Hunting Percival demonstration team, from left to right, W/C. A. N. Kingwill, Service liaison officer; R. W. J. Brown, technical sales manager; and S. B. Oliver, test pilot.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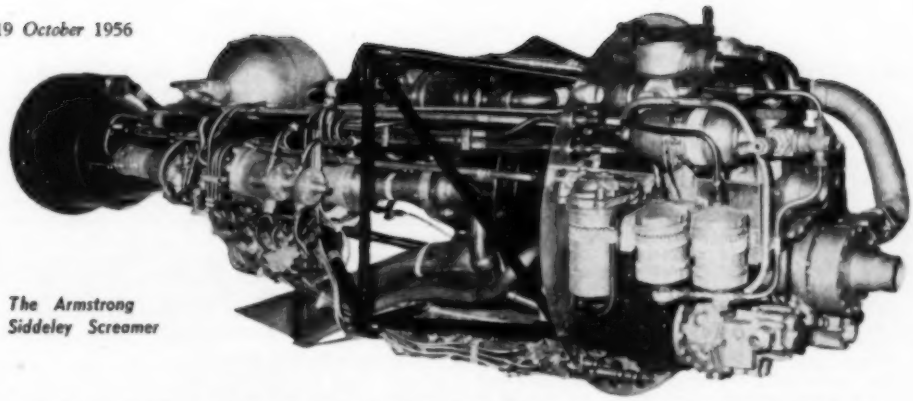


The Armstrong Siddeley Screamer

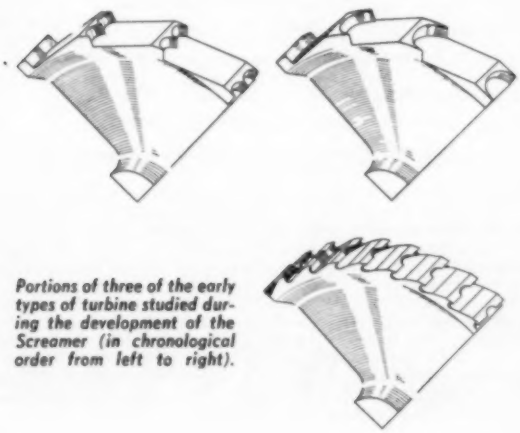
ROCKET-MOTOR DESIGN

A Paper by the Chief Engineer of Armstrong Siddeley Motors (Rocket Division)

LAST week a Royal Aeronautical Society Main Lecture was read at the R.A.F. Technical College before the Henlow branch of the Society. The author was Mr. Sidney Allen, F.R.Ae.S., chief engineer (rocket division) of Armstrong Siddeley Motors, Ltd., whose operations are based at Ansty, near Coventry.

As Mr. Allen pointed out in his opening remarks, little has previously been published on actual experience in designing and developing a rocket motor for a given application within a given time interval. He was therefore remedying this position by providing a full and authoritative account of the problems posed in the evolution of the Armstrong Siddeley Screamer. This is a single-chamber motor, running on liquid oxygen and aviation turbine fuel, intended for piloted aircraft application and with a design thrust controllable from 8,000 down to 800 lb. (It was fully described and illustrated with a cutaway drawing in *Flight* of July 27, 1956.) In its design (said Mr. Allen) there were three main sources of trouble: the wide thrust range required; the design of a turbo-pump unit operating on the rocket propellants; and dealing with the starting problem and at the same time maintaining the standard of safety and reliability required from the powerplant of a piloted aircraft.

It was early believed, continued the lecturer, that the main loss in specific impulse due to throttling (at high altitude) would be caused by combustion inefficiency. Nevertheless, gas-turbine designers were obtaining efficiencies well above 90 per cent on only a few pounds per square inch combustion pressure and it was accordingly decided to attempt to meet the whole range of thrust required with a single chamber. In the design of the turbo-pump, high-test peroxide was rejected as a working fluid, in spite of its attractions, since its inclusion would have meant the necessity of supplying three "strategic" liquids for the single powerplant. It was eventually decided to cut down development time by injecting water (i.e., steam) to provide a suitable working fluid for the turbine. The working fluid was prepared in a gas-generator unit comprising a small combustion chamber with appropriate injectors and igniter assembly. In the final design of gas generator it was found possible to use conventional swirl-type fuel injectors, three of which were inserted through the water duct at the upstream end of the combustion zone. The liquid oxygen was swirled in around a cup containing the igniter so that the oxygen was vaporized by the igniter flame before the fuel was injected into it. The feed to the turbine had a final temperature of about 920 deg K.



Portions of three of the early types of turbine studied during the development of the Screamer (in chronological order from left to right).

An accompanying sketch shows three of the early designs of turbine rotor which were examined. The first design had an efficiency of only 38 per cent, but this was raised to around 50 per cent by increasing the number of buckets from 13 to 33 and providing a "roof" over each bucket to prevent the working fluid from spilling out radially. Eventually, however, it was decided to design a conventional axial-flow, bladed turbine operating at a mean blade speed of 1,100ft/sec. The final design had blades of Nimonic 80A, fed from a single supply nozzle, and showed itself to be capable of providing adequate power with an efficiency of 60 per cent.

The three propellant pumps were of similar design, being open-impeller, centrifugal units with booster screws, similar to the smaller patterns developed for the earlier Armstrong Siddeley Snarler [fully described in *Flight* of August 6, 1954]. Development of the liquid-oxygen pump was hampered by cavitation in the light-alloy diffuser casing, a difficulty eventually overcome by a change to stainless steel. Another problem was that, although in the earlier Snarler engine the bearing nearest to the liquid-oxygen impeller was run dry, its life was considered inadequate for the Screamer. Accordingly, it was decided to lubricate all the bearings with oil mist from the gearbox, the oil/liquid-oxygen seal being an optically flat, stainless-steel ring mounted on a bellows and spring-loaded on to a sintered bronze ring impregnated with Fluon.

In the design of the combustion chamber, provision had to be made for a maximum fuel flow of about 4,000 gal/hr and it was not found possible to provide space for an adequate number of swirl-type sprayers. The best compromise appeared to be the provision of plain nozzles so disposed as to cause the fuel and oxygen jets to impinge on each other. Initially it was decided to increase the resistance of the inner shell to buckling by employing helical passage walls—provided to control the flow of regenerative cooling kerosine—as stress-carrying members machined integral with the inner shell. Development running showed that some form of film cooling would be necessary, but the scrolled inner shell did not lend itself well to such an arrangement. It was finally decided that, as water was already being carried for the gas generator, it could also be used to cool the chamber jacket. Calculations indicated that it should be possible to cool the Screamer with water forming 13 per cent of the total propellants and giving a theoretical specific impulse only a few points lower than that obtainable from the best mixture of oxygen and kerosine. Eventually the best design of chamber was found to be a throatless pattern with like-on-like impingement injectors.

Very extensive development was also necessary to produce the right design of valves, igniters and control system in order to provide safe and reliable starting and variable-thrust running with single-lever pilot control. During the starting cycle the initial acceleration of the turbine up to operating speed was achieved by supplying the liquid oxygen, kerosine and water from small pressurized tanks, each of which was designed to vent and refill automatically after each start. In the case of the starting tanks for water and fuel, expulsion bags proved to be a simple solution, but for the liquid oxygen it was found necessary to make the tank as a long cylinder fitted with a piston provided with Duaflex rings. The Screamer then became self-sustaining by feeding the turbine

ROCKET-MOTOR DESIGN . . .

with propellants supplied by the pumps, the complete starting sequence occupying less than three seconds.

The first firing took place in the spring of 1954 and subsequent experience rose steadily to a total of nearly 1,400 firings, representing more than 36 hours running, until development ceased at the end of 1955. On December 7, 1955, the flight-clearance test was passed at the first attempt, this consisting of 62 runs totalling 94 minutes, including—said the author—"such tricks as stopping the engine by running out of each propellant in turn, and attempting to start with no ignition rapidly followed by a normal start." After some rearrangement of the Screamer and the provision of a jettisonable liquid-oxygen tank, a practicable installation was made beneath the belly of a Gloster Meteor F.8 test bed. This aircraft would have been employed for the flight development of the engine had it not been decided that there was no application for a liquid-oxygen rocket motor for use in a piloted aircraft.

	Basic vehicle	S.I. doubled	Thrust doubled	Dry weight halved
Weight of vehicle at "all burnt" (lb)	500	500	500	250
Weight of vehicle at launch (lb)	5,000	5,000	5,000	4,750
Mass ratio	10	10	10	19
Thrust (lb)	8,393	8,393	16,786	8,393
Specific impulse (sec) ...	186.5	373	186.5	186.5
Jet velocity (ft/sec) ...	6,000	12,000	6,000	6,000
Burning time (sec) ...	100	200	50	100
Acceleration at launch ...	1.68g	1.68g	3.35g	1.77g
Acceleration at "all burnt"	16.80g	16.80g	33.50g	33.50g
Velocity at "all burnt" (m.p.h.)	7,220	14,450	8,320	9,850
Altitude at "all burnt" (miles)	54.0	215.9	34.6	64.5
Maximum altitude attained (miles)	425	2,517	537	831

In summing up his appraisal, Mr. Allen pointed out that the design of the Screamer was greatly influenced by the intention to make it suitable for piloted-aircraft propulsion. It had to be made completely reliable so that a pilot could start it or alter the thrust without restriction; one had to remember that engine failure at extreme altitude, for example, could cause an aircraft to go completely out of control. For other applications the Screamer would have been designed differently. In assisted-take-off installations the use of turbine-driven pumps would probably not have been justified, and if the motor was to be dropped by parachute it would probably have been practicable to reduce the fatigue life and durability of some of the heavier components. Furthermore, an engine with such an application could be calibrated to give the required thrust with minimum complication and could be overhauled after each operation, with simple, one-shot protective devices.

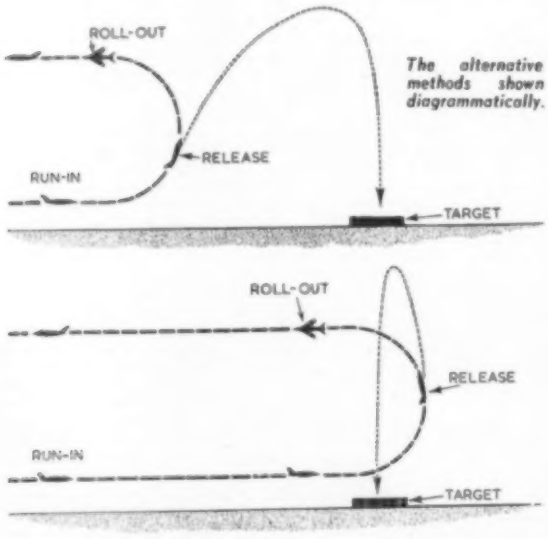
At the end of his paper Mr. Allen turned to the design of high-altitude sounding rockets [a relatively new field of activity for British rocket-motor design teams and one which is rapidly becoming of major importance.—Ed.] The accompanying table summarizes the performance which might be obtained from a given basic vehicle with various types of propulsion. It is particularly to be noted that doubling the specific impulse multiplies the maximum altitude by six without changing the maximum acceleration. Indeed, increasing the S.I. from 186.5 to 250 would have the same effect on altitude as would halving the dry weight, without any of the disadvantages attendant upon the latter.

An attempt to reduce engine weight would increase the maximum acceleration and consequently might even result in an increased structure weight. Specific impulse was therefore of major importance in reaching extreme altitude, even at the expense of increased engine weight. This contention, said the lecturer, was probably true for missiles generally, but for a.t.o. units dry weight was all-important, particularly where the motor was permanently installed in the aircraft, and for mixed-power machines the relative importance of S.I. and engine weight depended on the performance and duration for which rocket thrust was required.

LOBBING A BOMB

INFORMATION has recently been released concerning a method, evolved by the U.S.A.F., of delivering a small atomic bomb from a low-flying aircraft in such a way that the attacker is not endangered by the explosion. Loft bombing is the term used by the U.S.A.F. to describe the new technique, which involves lobbing the bomb upwards and imparting to it a trajectory similar to that of a mortar bomb. The equipment employed is known as L.A.B.S., the initials standing for Low Altitude Bombing System.

In many cases it is desirable to approach a target at low altitude, both to achieve accuracy and to stay as far as possible below early-warning radar coverage. For a L.A.B.S. run the attacking aircraft—usually a fighter-bomber, e.g., F-84F or F-100, or light bomber, e.g., B-57—dives from its cruising altitude to run-in to the target at very low level from a predetermined landmark. The L.A.B.S. is set by the pilot and, at a given point, about two miles short of the target, the autopilot puts the aircraft into the first part of a loop. At the optimum angle of climb the bomb is automatically released, to follow a trajectory similar in path and speed to that of an 81 mm mortar shell. Assuming an aircraft speed of 500 m.p.h., the bomb will rise for 23 sec and fall for about the same time, giving the aircraft 46 sec in which to roll off the top and make good its escape.



The alternative methods shown diagrammatically.

In cases where lead-in features are few, the aircraft goes right up to the target, the L.A.B.S. system being set so that the half-loop is initiated immediately over the target. The bomb is released when the aircraft is just over the vertical, so that it is thrown almost vertically upward, to fall in a very steep trajectory on the target below. Meanwhile, the aircraft rolls off the top and gets away.

Manufactured by Minneapolis-Honeywell Regulator Company, L.A.B.S. equipment is now fitted to the majority of U.S.A.F. fighter-bombers. A L.A.B.S. run was demonstrated during the first public showing of the F-84F in England at Bentwaters, Suffolk, two years ago.

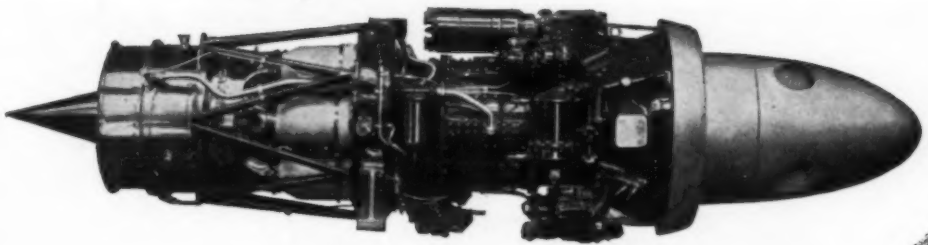
It is now reported that a system similar to L.A.B.S. is being developed for the R.A.F. The first part of the loop, during which the bomb is released, would be controlled by an autopilot; and the range is stated to be about ten miles. The most likely R.A.F. type to employ the technique would appear to be the Canberra. Particular advantages of this method of bombing are reported to be that the bomber does not have to fly right over the target when lobbing the bomb forwards and would give little or no warning of attack. It would also be very much more difficult to assess the bomber's intended target.

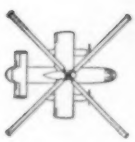
CANADIAN/U.S. LECTURE MEETING

RECENTLY announced by the Canadian Aeronautical Institute is the programme for the third joint meeting of the C.A.I. and the Institute of the Aeronautical Sciences, which is to take place in Toronto on November 26-27. The W. Rupert Turnbull Lecture on this occasion will be given by Mr. Simon Ramo, executive vice-president of the Ramo-Wooldridge Corporation.

The first morning's discussion at the meeting will be devoted to test flying, and the Turnbull Lecture will be delivered in the afternoon. The principal speaker at the dinner that evening will be Dr. C. C. Furnas, Assistant Secretary of Defense (Research and Development), U.S.A. The second day's concurrent morning subjects are quality control and electronics, and the final afternoon session will be concerned with missiles.

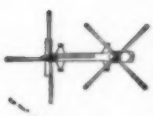
3 engines of increasing importance





ELAND The Convair 340 aircraft converted to Eland engines will be on demonstration flights in Europe during this year. Another aircraft conversion to *Elands* is the Elizabethan, which will be evaluated on BEA routes. Napier *Elands* fitted with auxiliary compressors for the tip-driven rotor system, will power Fairey's new large transport helicopter, the Rotodyne.

ORYX The Napier *Oryx* 780-950 gas h.p. turbo-gas-generator provides the hot gas which is ducted to the rotor head for the propulsion of helicopters by jet reaction at the rotor blade tips. This system eliminates all mechanical transmission. The *Oryx* has been officially Type Tested at 780 and 865 gas h.p.



GAZELLE *Gazelle* 1260-2000 s.h.p. A rugged new free turbine engine for helicopters —selected for the Royal Navy Westland "Wessex" and the R.A.F. twin-rotor Bristol 192. For ease of installation it can be mounted in any position between the vertical and horizontal. Helicopters demand tough, reliable engines—the *Gazelle* is designed for strenuous duty, long service between overhauls while its outstanding simplicity means economical and speedy maintenance.

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(Above) Not take-off, but a dusting run at zero feet by an NA-75. (Right) Complete removal of the ten metal fuselage-panels from firewall to tail, for inspection and maintenance, needs only five minutes, two men, and two screwdrivers.

DUSTER-SPRAYER

New Variant of the Well-tried Stearman

MANY American-trained wartime pilots of the R.A.F. and Royal Navy will recall with affection the handling qualities of the Boeing (Stearman) Model 75 PT-17 and N2S trainers on which they completed primary training. Since the war, in similar fashion to this country's Tiger Moth, the ubiquitous Stearman has been adopted and adapted for a variety of jobs of work, including the important agricultural tasks of crop-spraying and dusting. Recently designed and put into production by the National Aircraft Corporation of Burbank, California, is the NA-75, an improved variant with three major innovations.

The first of these changes is the use of National's "Hi-Lift" wings, of Göttingen 398 section, which reduce the stalling speed of the machine (empty) to 35 m.p.h. These wings, which have been in use with Stearman operators for over two years, have a fabric-covered all-metal structure, and incorporate end-plates. To facilitate quick repairs in the field, the design permits assembly or repair with ordinary screwdrivers and wrenches, while fabric sewing or rib stitching is eliminated by the use of fabric-clips. The leading-edge, which is not fabric-covered, is assembled in small sections for ease of replacement of any damaged part.

All-metal stressed-skin construction is used for the wing centre-section; all flight and engine instruments have been removed from the cockpit and are mounted on the centre-section trailing edge.

The main modification to the fuselage of the basic Model 75 is the use of removable metal panels covering the standard Stearman welded steel-tube structure. For inspection, maintenance, or the removal of corrosive chemicals, these fuselage panels can be detached by two men in five minutes. The cockpit is padded with a six-inch crash pad, and cutting edges (as a precaution against sudden encounters with telegraph wires and wire fences) are fitted to the landing gear, wing struts and fin. The aircraft is designed to fly normally in a nose-down attitude, in order to provide improved visibility.

The third main innovation in the NA-75 is the adoption of new dispersion equipment permitting an instant change from dusting to spraying operations and *vice versa*. A combination dust/spray hopper of reinforced glass-fibre construction and 31.7 cu ft capacity is located in the forward fuselage, with a liquid-tight dust gate acting as an emergency dump valve.

To reduce drag, the pump, agitator drive, shut-off valve and all piping to the spray boom are fitted inside the fuselage. The spray pump and dust agitator are engine-driven through a variable-speed power take-off. A low-drag aerofoil type of dusting venturi is used, and the spray boom is mounted on the trailing edge of the lower wing.

The NA-75 can be powered by the Continental 220, Lycoming 225 or 300, Jacobs 245 to 300, Pratt and Whitney 450 or Wright 425 engines. Typical take-off distances are quoted as 890ft with 1,250 lb payload (220 h.p. engine), and 785ft with 2,000 lb payload (450 h.p. engine).

JOHNNIE JOHNSON'S STORY

THE following review of a recently published book which is attracting considerable interest has been specially written by Marshal of the Royal Air Force Sir John C. Slessor.*

NO one who wants to know what the air war was really like—anyway from the point of view of the fighter squadrons—can afford not to read this book by one of the most deservedly famous fighting officers in the short but glorious history of the R.A.F.

I confess I usually open a book of this sort with a rather sinking heart. But this one is really good. The story, of course, is magnificent—the record of the brilliantly successful fighting career, from the Battle of Britain to victory in Germany, of the man who shot down more enemy fighters than any other R.A.F. officer. Too often these splendid stories are spoilt in the telling. G/C. Johnson, on the other hand, writes nearly as well as he flies and fights—which is saying a good deal. In his modest, straightforward, often superbly graphic account of nearly five years of fighting in the air, one keeps coming across little passages which could hardly be bettered—simple and unforced, and with an economy of words which many professional writers would do well to emulate.

I had the advantage (which some reviewers necessarily lack) of knowing the man and his record, including his service in Korea. I remember the enthusiasm with which Lord Trenchard spoke of him after meeting him on his return from Korea. Yet, reading this book, I found myself surprised not at his personal fighting capacity, which I knew, but at the way in which this young civil engineer developed in such a short time into a professional junior leader of outstanding quality, by his level-headed tactical judgment, his unselfish insistence on *team* fighting in the air—in other words, I suppose, by his outstanding qualities of leadership—which he developed so quickly. He was and is something far more than a first-class fighter.

Johnson is a countryman and a lover of field sports—though he is, perhaps, a little hard on fox-hunters! And I liked the way in which his occasional very brief references illuminate the patient courage of his young wife; we sometimes tend to forget the constant, gnawing anxiety that the wives of these gladiators had to endure.

I have never had any doubt that G/C. Johnson has a great career before him as well as behind him in the Royal Air Force. I hope now that he will also write more—for he can write.

*"*Wing Leader*," by G/C. J. E. Johnson, D.S.O., D.F.C. Chatto and Windus, Ltd., 40-42 William IV Street, London, W.C.2. Illustrated. Price 15s.

KAMAN'S ROBOT

Potentialities of a Remotely Piloted Helicopter

THE Kaman Aircraft Corporation of Bloomfield, Connecticut, manufacturers of the K.600 helicopter, have developed an experimental radio-controlled version of the machine for military use. The project was initiated in August 1952, when the U.S. Navy placed a contract with Kaman for the development of a remotely controlled helicopter using a combination of the automatic stabilization equipment then being developed by the Navy Bureau of Aeronautics and a guidance system originating in the Office of Naval Research. A radio-control system and electro-mechanical controls were developed, based on those of conventional target drones, but adapted for the helicopter's peculiar flight conditions.

In May 1953, the first remote-controlled machine flew, and in September of that year it was demonstrated to the U.S. Navy. At that time the machine was flown with a helicopter pilot at the ground control point, but subsequent work produced a control system by which, in April 1956, a Kaman employee who had never before flown in any kind of aircraft made the robot helicopter take off, manœuvre and land successfully. Since then all robot flights have been made by men who are not pilots, although a check pilot is required to sit at the helicopter's normal controls for safety reasons.

In June 1955, the U.S. Navy and Army placed a joint contract for three remotely-controlled Kaman helicopters for evaluation. At the same time Radio Corporation of America became interested in the possibilities of mounting in the machine the back-pack television camera and transmitter which they had developed for the U.S. Army Signal Corps. The potentialities of this line of development are manifold and significant. The helicopter can be guided from a control station on the ground or in another aircraft, or by what is described as a "memory" system, presumably a programmed control. These three systems can also be used in combination, control being handed over from one to another as required. Special applications which have already been tested include simulated battlefield surveillance, using the television camera and transmitter; the laying of telephone cable; and the transporting and automatic unloading of cargo in inaccessible areas. Still and ciné cameras can also be installed to make permanent records of battle situations.

These tactical applications are obviously extremely attractive, but still further developments are possible. The robot helicopter could be used in conjunction with television to seek out target areas and drop smoke-bombs as visual markers for artillery fire. The machines could be made to lay smoke-screens to obscure troop movements, or lay and detonate lines of explosives through mine fields, thus clearing a path for troops and vehicles; and yet another adaptation, the company claims, might be the use of robot helicopters for hunting and destroying enemy tanks and vehicles.

The K.600 under radio control, with safety pilot aboard.

Another recent Kaman development is an automatic hovering device which enables a helicopter to maintain position above a fixed point on the ground with no pilot-assistance. On tests with a Kaman HTK-1 equipped with automatic stabilization equipment the machine was automatically hovered in a beam of light projected vertically. Horizontal control was by photo-electric cell sensing and vertical control by a sensitive barometric device. At a height of 1,000ft, the helicopter stayed within a 20-ft circle in winds of between 20 and 30 m.p.h. for periods up to 20 minutes. The main practical application foreseen for this development is in ground surveying and topographic mapping; the helicopter, it is considered, could provide an elevated surveying target for long-range work.

NEW HEADSET AND OXYGEN MASK

AN adjustable, lightweight headset for civil use with normal or pressure-breathing oxygen mask has been developed by Airmed, Ltd., South Road, Temple Fields, Harlow, Essex, in conjunction with B.O.A.C., and is now in production. Originally projected by Dr. J. Gabb and Mr. A. Lucking of B.O.A.C., the equipment is already in use by B.O.A.C. Britannia crews. Its design is stated to be more advanced than that of most equivalent military equipment and to have aroused considerable interest in the U.S.A.; Douglas, Lockheed and other American and Canadian companies have ordered or are testing it. Agents for the Western hemisphere are Scott Aviation Corp., Lancaster, New York.

The Airmed headset.

The new oxygen-mask toggle-frame headset, as it is termed, consists of a special lightweight, reversible set designed to give maximum comfort and sound attenuation. Full adjustment can be made quickly. Permanently attached to the headset is a boom microphone which can be swung into position on either side and is adjustable in length. To the headset can be fitted a toggle frame carrying a standard oxygen mask, with integral microphone and supply tube. The frame can be easily attached to the earphone mountings and, when not in use, hangs on the chest and does not restrict head movement. When required it can be applied and fastened down simply and rapidly to give a pressure seal suitable to the type of mask used. To counteract the forward pull of the mask on the headset a small cloth strap is attached by quick-release fasteners across the back of the head.

The toggle frame is so designed that by single-handed operation a full facial seal can be obtained within eight seconds where the toggle frame mask is stowed near the crew member, within five seconds where the mask is worn attached to one side of the headset, and within two seconds when it is worn attached to both sides of the headset.

The result is a headset for normal use offering a rapid and comfortable emergency oxygen facility for crews of pressurized civil aircraft. The equipment is not so cumbersome or irksome that airline crews will not willingly wear it on long flights. Preliminary list price for the complete headset, toggle frame and oxygen mask is about £39.

"EXECUTIVE" AUTOPILOT

A NEW three-axis autopilot for business aircraft, weighing only 8.5 lb, is now in production by Tactair, Inc., a division of the Aircraft Products Company, Bridgeport, Pennsylvania. This equipment will be placed on the market early in 1957. Development has been in hand for the past three years, and for two years four prototypes of the autopilot, which employs neither motors nor electronic valves, have been flying in Beechcraft Bonanzas.

NAVIGATION IN AIR TRANSPORT

Captain Majendie's Presidential Address before the Institute of Navigation

IN the introduction to his presidential address to the Institute of Navigation, due to be given last Tuesday, October 16, Capt. A. M. A. Majendie* said, "My predecessors in this office have been men of considerable scientific and administrative distinction, able to talk with authority in their respective fields of learning. I, however, come before you mainly as a practitioner of air navigation, the first such to be your president, and concerned mainly with the practical business of 'how to get there' in an imperfect and only partly understood world rather than with the elegant demonstrations of a theoretical technology." Further quotations, emphasizing specific points from Capt. Majendie's comprehensive review—which had as its theme "The Place of Navigation in Modern Air Transport"—are given below.

SPECULATING recently on the future growth of air transport, a writer took as his motto: "Behold the turtle—she advances only by sticking her neck out." This is true not only of turtles, but exemplifies the spirit which is needed to meet the challenge of the future.

* * *

The task of navigation in air transport is so to direct the path of an aircraft that it can execute with safety any flight planned to come within its technical performance capability, and without loss to its practical operating and economic potential. How well this task can be achieved in practice depends on the three main component parts, which together make up the framework within which it has to be accomplished. These are the aircraft itself, the natural environment in which it must be operated, and the artificially created restrictions imposed by air traffic control.

* * *

The lecturer.

The supersonic transport aircraft is hardly yet over the horizon of the future, but it cannot be ignored in any pattern of forward thinking. The considerations which govern the operation of the subsonic machine need considerable modification if they are to be applied to it. All that need be said here is that the general pattern may not be too dissimilar, but that there may well be a greater effective range of operating speeds and heights. Against this slight easement in flexibility of operation must be set a burning thirst for fuel, which will prescribe rigid limitations to the duration of flight; to this, probably, only nuclear power is capable of providing a solution.

* * *

Viewed from the cockpit the surrounding atmosphere can be in motion either horizontally or vertically, or both; can be hot or cold; and can be clear or cloudy. In addition, it can support particles of water in a variety of different guises, ranging from mist to hailstones, and can exhibit a considerable variety of electrical phenomena. The theme of this ocean of air is one of dynamic inconstancy, an ever-changing pattern of mood and motion. Many of these phenomena are real enough to the pilot or navigator, but do not appear in the formal calculations of the aircraft's performance engineer, or of the air traffic control planner. Despite the great advances in meteorological forecasting made in the last twenty years, it is clear that the pre-flight forecast can be little more than a generalized statement of probability, until such time as real prediction can be achieved by computer techniques.

* * *

We are faced, then, with the need to operate our transport aircraft, which are by any standard sensitive and precise machines, in the highly irregular medium of the atmosphere. In order to obtain the best results from any particular flight, it is necessary to preserve an individual freedom of action, so that the navigation of the particular aircraft can be sufficiently flexible to enable it to adapt its plan of flight to meet the conditions actually encountered. The independence of the aircraft from any prepared path in the horizontal, and its limited freedom of operation in the vertical, ensure that a large part of the flexibility needed will, in fact, be available from the standpoint of performance. Whether it is possible to use this flexibility depends on two factors: first, whether sufficient information can be made available to assess the actual weather situation throughout a flight, in order to determine the optimum course of action: and, secondly, whether it is possible for individual aircraft to retain the necessary freedom of manœuvre without risk of collision between each other.

**Formerly flight captain of B.O.A.C.'s Comet fleet; now aviation research liaison officer, Smiths Aircraft Instruments Ltd.*

In broad terms it may be said that the general approach to the problem of air traffic control consists entirely of the denial to the aircraft of its principal and unique quality of three-dimensional flexibility of manœuvre: the three-dimensional problem of safe separation between aircraft having been found too intractable for easy solution, the problem is simplified by reduction to a series of two-dimensional ones. This is achieved by confining aircraft to a limited number of selected flight levels. Having thus removed a large part of the vertical flexibility, the problem is still generally found to be too difficult unless aircraft are further restricted to defined tracks within the individual flight levels. A notable exception to this arrangement is the growing use of radar sequencing in the congested terminal areas around some of the bigger airports. However, the major problem remains, the outcome being to reduce the performance capabilities of the aircraft to those of a particularly fast express train, and its peculiar ability to afford free passage upwards as well as forwards is for this reason largely annulled.

It must not be thought that there is any easy solution to the problem, or that the suggestion is being made that alternative methods of providing safe separation between aircraft could have been made successfully in practice, and within the restrictive limits of time, technical feasibility, and finance. Nevertheless, the outcome is a sorry business, and bodes little good for the healthy future development of air transport. Perhaps the most serious aspect of the matter is the mentality it has engendered in the minds of many people, making it difficult for them to think of flight except in terms of rail tracks in the sky.

* * *

Against this background we can review the place of navigation in modern air transport. This can best be done by considering four sub-divisions. These are, respectively, the long-term planning of aerial transport; the planning of a particular flight; the en-route conduct of that flight; and, finally, the peculiar problems of approach and landing.

Long-term planning must take into account two essentially different types of basic data. First there must be an adequate grasp of the appropriate sciences and of the environmental circumstances of the operations. These together provide the absolute framework of any plan. Secondly, there are the relative limits set by human design or incapacity. It is these latter that the planner must keep constantly under review, for, if he does not, they may come to be accepted as absolutely as must be those of the first type. Furthermore, it is essential that the possible interaction of these relative limits be carefully watched, if progress is not to be impeded. Otherwise strange things may happen. If, for example, we allow too restrictive an approach on the part of those responsible for air traffic control to dominate our operational philosophy, this may eventually affect the basic design of new aircraft types, and hinder what could otherwise be the unfettered development of applied aeronautical science. At all times we must keep as our basic yardstick what we could achieve in the absence of arbitrary or empirical limitations, and make use to the full of the available technology and skills. One of the peculiar merits of the Institute of Navigation is that it is ideally suited to assist in providing such a yardstick.

The problems of planning a particular flight are very much more clearly defined, and offer considerably less scope for the exercise of individual judgment, mainly on account of the broad background of current experience generally available. For this reason it is not too unusual nowadays to find that flight planning has become a more or less fixed routine conducted from a well developed set of rules. This is right and proper, and we could feel little confidence in air transport were it to be otherwise. The essence of the problem in most types of air transport operation is to achieve a repetitive task with a high degree of consistency. It is right to expect such consistency naturally from the aircraft itself, for it is essentially a precision instrument. It is futile, however, to expect any such characteristics from its operational environment, and therein lies the heart of the problem: how to achieve consistency and reliability with a highly precise instrument operating to close tolerances in a fickle, and, to some extent, unpredictable medium? The short answer is, of course, obvious; to provide the craft with a flexibility of application that can at all times match the vagaries of its environment. If this could be achieved flight planning would consist mainly in setting out the limiting conditions likely to be encountered, and within which

NAVIGATION IN AIR TRANSPORT . . .

a standard plan could be maintained. The randomness of current operations would thereby be reduced or eliminated.

* * *

It will be readily appreciated that many, if not all, of the traditional functions of the navigator can be taken over by automatic devices. The development of new radio aids, particularly for use over long distances, such as Dectra, Navarho, Radio Web, etc., are all intended to provide direct information of position. From the point of view of the aircraft it is interesting to note, in passing, that the important emphasis is to enable it to adhere continuously to its intended flight path; whilst progress along this path need only be checked at intervals. Clearly this can be achieved by a suitable combination of fixing aids and automatic dead-reckoning devices. In this context we must remember to include the new inertial navigational systems in the latter category. Such a complex of airborne navigational equipment should have a sufficiently large redundant multiplicity in the total system, in order to eliminate the risk of operational failure owing to the technical malfunctioning of one or two individual components.

* * *

The human navigator is profoundly conscious of his working environment, and of the various practical problems that are constantly encountered in the air, and some of which have already been mentioned. The automatic navigator has no such understanding, and can only reflect the knowledge and attitude of its designers. It is going to be increasingly difficult for these designers to keep themselves adequately informed of all the practical circumstances in which pilots will have to use their equipment. Similarly, the growing complexity of the equipment itself will ensure that practising pilots understand less and less of its basic principles. Unless drastic action is taken to prevent it, there is undoubtedly going to develop the very real problem of progress being blocked by the inability of these two classes of individuals to understand thoroughly each other's problems. Once again we can foresee the valuable rôle which the Institute of Navigation can play in bringing together the various diverse interests which must combine successfully if proper progress in navigation is to be ensured.

* * *

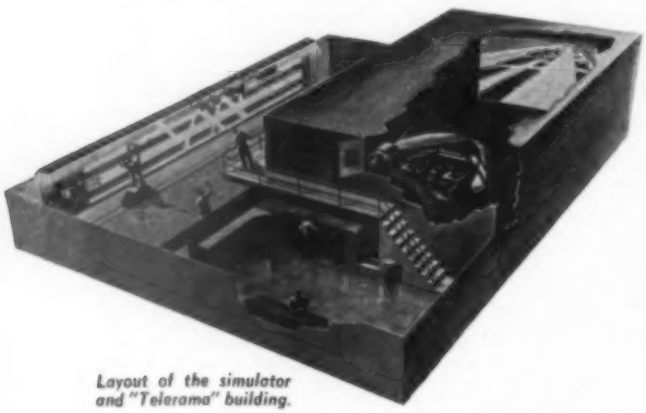
The precision of both information and guidance required to achieve a safe approach in bad weather is of a very high order. First we have the problem of suitably displaying to the pilot an adequate "situation report," so that throughout an instrument approach he is never in doubt about what is going on. Secondly, we have the problem of displaying to him suitable guidance signals so that he can control the aircraft in an adequate manner. And, finally, we have the problem of using such guidance signals in conjunction with an automatic pilot.

* * *

The art or science of navigation does not disappear with the emergence of automatic guidance, but there is a very real risk that progress in the purely navigational sense may come to a virtual standstill on this account. Let us not forget this, or we fall into the serious error of confusing the end with the means chosen for its accomplishment. Our end must remain the safe and efficient transport of passengers and goods by the fastest and most flexible craft yet invented, in as economic and unfettered a manner as we can devise.

DC-8 FLIGHT SIMULATOR

AS a help in certain development problems and to provide early crew-training facilities, the Douglas Aircraft Company of Santa Monica, California, has designed a DC-8 flight simulator which is being manufactured by Link Aviation, Inc. The simulator incorporates a modified fixed-base principle allowing for



Layout of the simulator and "Telerama" building.

hydraulic simulation of pitch, roll, rough-air and vertical-acceleration effects on the crew compartment mock-up.

In addition Douglas have developed a means of reproducing a realistic background, to provide visual as well as instrument flight training. The system by which this is achieved is called Telerama; it entails the projection on a 15ft screen of a model airport scene viewed by a camera mounted on a base which moves according to the speed, course and height indications in the simulator cockpit. The general layout of the simulator installation is illustrated by the picture. In addition to the partially moving base, the DC-8 simulator has facilities for reproducing relevant aircraft noises and all emergency situations.

I.G.Y. HIGH-ALTITUDE RESEARCH

IN a lecture to the British Interplanetary Society on October 6, Professor H. S W. Massey, F.R.S., chairman of the Gassiot committee (which is responsible for "Skylark," the British high-altitude rocket), discussed the study of the high atmosphere during the International Geophysical Year.

Prof. Massey said that although our knowledge of the earth's atmosphere had increased during the last decade, none of the phenomena such as auroræ and night air-glow were really understood. Even such commonplace data as pressure, density and temperature were known with moderate certainty up to only about 100 miles. During the I.G.Y. these and many other items were to be investigated by the sounding-rocket programmes of the U.S.S.R., U.S.A., France, Japan and Great Britain. In addition both the U.S.S.R. and U.S.A. were to launch a number of artificial satellites.

The British rocket programme was to be thorough in a limited number of fields, rather than extensive. Only one type of vehicle, powered by a solid-propellant rocket motor, was to be used; but firings would be carried out from several places, including Woomera and Fort Churchill in Canada. One of the experiments was to be the investigation of the variation of temperature and wind speed with height. The technique to be used was a refinement of one already employed in the American programme. Grenades were to be ejected and fired at regular intervals. An array of microphones and wide-angle cameras on the ground would record the flash and the sound of each grenade against an accurate time datum. The difference in times for the sound to arrive would give the vertical variation of the speed of sound and hence the temperature. The angle of arrival of the sound could be used to determine high-altitude wind speeds.

A further and more spectacular experiment was to be the release of metallic sodium at about 40 miles' altitude during twilight. At this time of day a phenomenon known as "resonance absorption" of the sun's radiation would make the sodium cloud glow, and it could thus be readily observed from the ground. By noting the motion of the cloud, wind speeds could be measured; and by taking spectrographic readings the local temperature could be determined.

LINK WITH CANADIAN PIONEERS

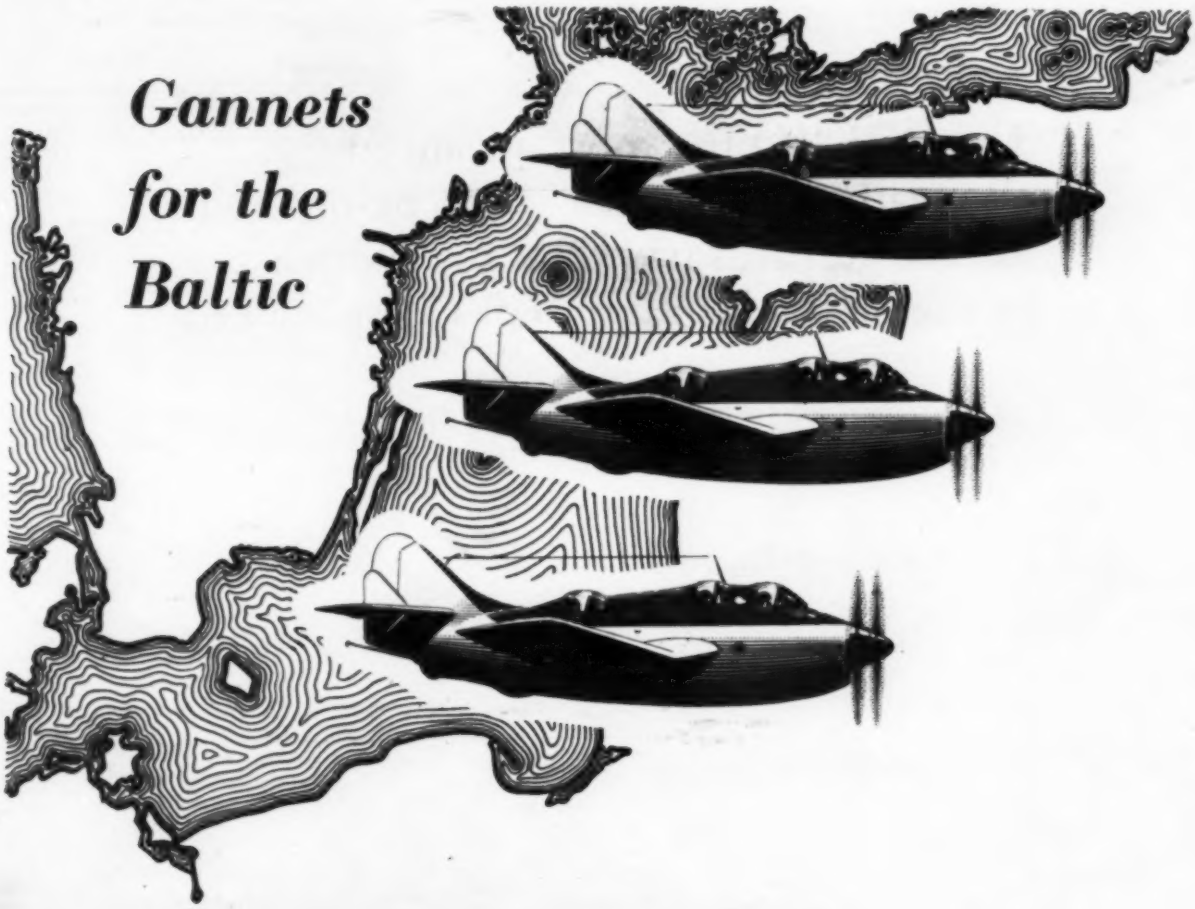
RELICS and records of the aeronautical work of Dr. Alexander Graham Bell are included in the collection of scientific material displayed in the recently opened Alexander Graham Bell Museum at Baddeck, Nova Scotia.

Bell's aeronautical research work is briefly recalled in the current issue of the *Canadian Aeronautical Journal*. When his work with kites had reached a stage where he required engineering assistance, the *Journal* recollects, he obtained the help of two young engineers, J. A. D. McCurdy and F. W. (Casey) Baldwin, and with them, Glenn Curtiss and Lt. Tom Selfridge, formed the Aerial Experiment Association in 1907. The Association was financed by Mrs. Bell.

This group built five aircraft, including the Red Wing, in which Baldwin made the Association's first flight (and the first flight by a Canadian) at Hammondsport, N.Y., on March 12, 1908; and the Silver Dart, in which McCurdy made the first flight by a British subject in the British Empire on February 23, 1909, at Baddeck.

In March 1909 the Association was dissolved and replaced by the Canadian Aeroplane Company, which built five more aircraft; these included the Baddeck II, the ailerons of which are among the exhibits in the new museum. "The invention of the aileron," the *Journal* states, "was perhaps the Aerial Experiment Association's most important contribution to Aeronautics."

Gannets for the Baltic



WESTERN GERMANY has indicated the intention to order a unit of anti-submarine Fairey Gannets for its shore based Naval air arm. The Gannet, already in service from the North Sea to Australian waters, will thus soon be seen over the Western Baltic coastal waters—a significant addition to the long list of seas and oceans under Gannet surveillance.

FAIREY

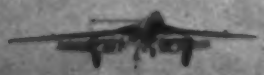
ANTI-SUBMARINE AIRCRAFT
CARRIER-BORNE & SHORE BASED

Gannet

Powered by the Armstrong Siddeley Double Mamba

THE FAIREY AVIATION COMPANY LTD · HAYES · MIDDLESEX
ENGLAND · AUSTRALIA · CANADA

The D.H.110, the most advanced
all-weather interceptor yet to be ordered
for the Royal Navy, is in production
by the de Havilland Aircraft Company Ltd.



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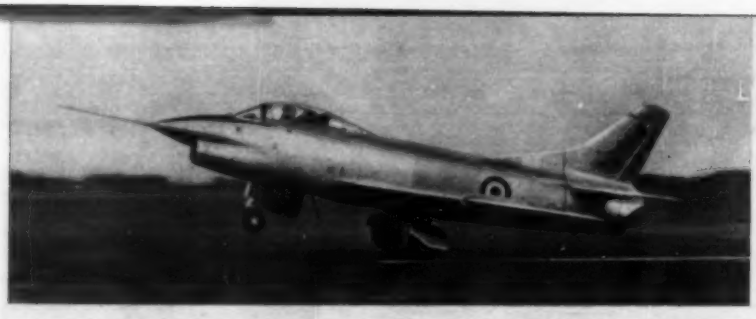


Subject of a news paragraph on this page is the Fiat G.91, seen on take-off. The curiously marked Meteor is referred to in an item—"Meteor Markings"—in column one.

AIRCRAFT INTELLIGENCE

Great Britain

Short S.B.5. Although little has been heard of this unique research aircraft for many months it is still in being, and final trials, with the full (69 deg) wing sweep configuration, should soon be under way. The possibility of fitting an auxiliary turbojet beneath the fuselage is being considered. It will be recalled that the S.B.5 was built to determine the low-speed characteristics of the English Electric P.1.

Meteor Markings. One of the photographs above shows Meteor F.8 VZ494 of the A.P.S. (Armament Practice School) at Acklington. The markings are yellow and black and are included on the wing-tips. Aircraft of the School often accompany squadrons of the Royal Auxiliary Air Force to their training camp in Malta.

Canada

Temco TT-1. A series of technical and flight-evaluation tests of the Temco TT-1 primary jet trainer was recently completed by a team of R.C.A.F. officers. The Canadians were at Temco's Dallas, Texas, plant for five days, and are reported to have been "attempting to determine the feasibility of commencing a student's flight instruction in jet-powered aircraft." The TT-1 has already been selected for use as the U.S. Navy's first primary jet.

U.S.A.

Douglas STOL/VTOL. It is reported by *Aviation Week* that the U.S. Army is very interested in a Douglas STOL/VTOL design, described as an outgrowth of studies which started years ago for a DC-3 replacement. Douglas have remained interested in such an aircraft after studying, and having abandoned, helicopters. "The project is not yet firmed up as a military commitment, and may very soon become a commercial venture in another version," reports our contemporary.

Douglas B-66 Destroyer. The name Destroyer has been conferred upon the B-66 bomber, U.S.A.F. counterpart of the A3D Skywarrior.

France

Bréguet 1050 Alizé. The name Alizé (Tradewind) has been conferred upon the Bréguet 1050 anti-submarine aircraft for France's Aéronautique Navale. The first pre-production Alizé was recently transported to the Toulouse-Montaudran airfield, where it will be assembled for flight testing at Toulouse-Blagnac. The engine is a Rolls-Royce Dart, and the Society of British Aircraft Constructors announces that the Alizé promises to provide a steady market for this unit—the most widely used turboprop in the world.

Italy

Fiat G.91. Since its successful first flight at Turin/Caselle on August 9, the Fiat G.91 light fighter has made good progress. Early flights have indicated a particularly good performance and a short take-off run which will render it particularly suitable for tactical operations from small grass fields. The Bristol Orpheus engine has behaved excellently and the higher thrust of later marks will further improve performance. The first flight was made by Fiat test pilot Capt. Riccardo Bignamini and lasted for 30 minutes. The G.91 was the winning design in the NATO light tactical fighter design competition held two years ago. In outline, though not in size, it closely resembles the North American F-86K.

Spain

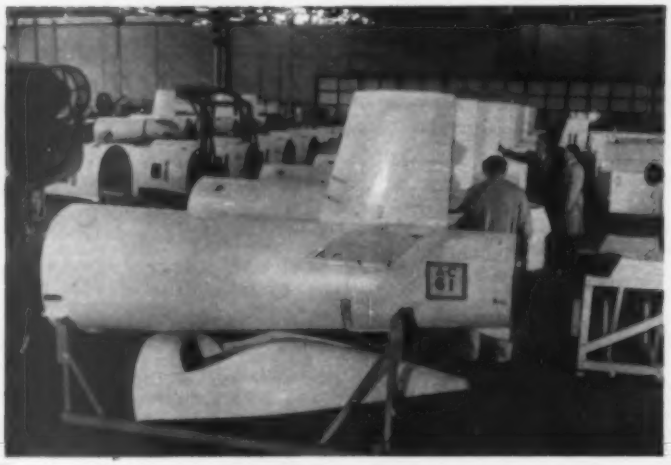
Light Fighters. Respectively projected by Hispano Aviacion S.A. and Construcciones Aeronauticas S.A. are light fighters designated XC-6 and XC-7. The former machine is a delta, designed by Professor Willi Messerschmitt and bearing the works designation HA-300. The XC-7 is also a delta and is alternatively known as the XH-101.

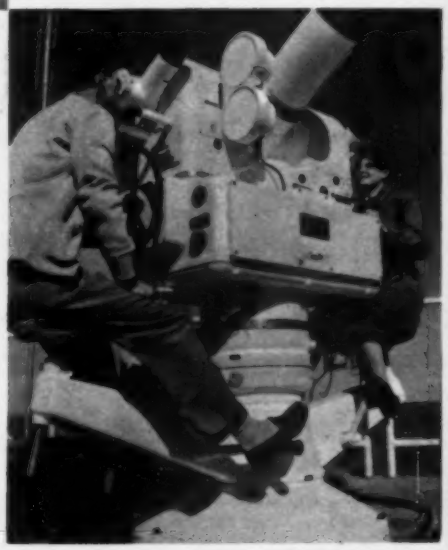
Japan

Air Strength. At the end of August Japanese military air strength totalled 687 aircraft, made up as follows: L-5, 33; L-19, 103; L-21, 56; KAL-1, 1; H-13, 14; H-19, 5; P2V-7, 6; PV-2, 16; TBM-3W, 10; TBM-3S, 10; PBY-6A, 2; JRF-5, 4; KAL-2, 2; T-34, 113; SNJ, 11; S-51, 3; S-55, 3; F-86F, 63; C-46, 30; T-33A, 72; T-6G, 128; Vampire Trainer, 1; T-28B, 1. Civil aircraft totalled 135, specifically: Cessna 170B, 19; Cessna 180, 3; Cessna 195, 6; Piper Super Cub, 7; Piper Pacer, 4; Piper Tri-Pacer, 4; Aeronca Super Chief, 1; Fletcher FD-25, 2; Ryan Navion, 1; Beechcraft Bonanza, 4; D.H. Chipmunk, 1; Auster J5F, 2; Auster J5G Autocar, 4; DHC-2 Beaver, 4; Beechcraft D-18S, 4; Beechcraft E-18, 3; Aero Commander 520, 1; Beechcraft Twin Bonanza, 3; Piper Apache, 2; Douglas DC-3, 4; Douglas DC-4, 8; Douglas DC-6B, 5; D.H. Dove, 7; D.H. Heron, 3; Handley Page Marathon, 2; Bell 47D-1, 12; Bell 47G, 5; Hiller UH-12B, 2; S-55, 3; S-51, 2; N-52, 1; R-52, 1; R-53, 1; Y-1, 1; KAL-1, 1; KAT-1, 2.

The Saab-91B-2 Safir trainer, wearing the markings of the Royal Norwegian Air Force, is the first of a series of 25 ordered by that Service. Already Safirs are being operated by the Swedish and Ethiopian Air Forces. The Hunting Percival President, seen in a "Flight" photograph, is a civil-transport development of the military Pembroke.

Jindivik designer: Mr. Ian Fleming, chief designer at the Government Aircraft Factory, Fishermen's Bend, Melbourne.





(Top left) A Jindivik 2 (Armstrong Siddeley Viper) equipped with wing-tip camera pods to record near misses. (Centre left) The Jindivik is designed for speedy assembly; in this recent picture the serial is a clue to the numbers built. (Centre right) Long-range ciné camera employed at Woomera to record the flight of the targets. (Below, left) Typical of the Woomera landscape—except that water seldom figures in it—is the picture of a stockman's lonely grave at Phillip Ponds. Also typical of the area is the kangaroo—seen fleeing from the shadow of a Sycamore.

SPEAR THROWER

THE above title translates into aboriginal Australian as "Jindivik," and many of these trim radio-controlled target aircraft are now in daily use on the great range at Woomera. Powered in Mk 2 form by an Armstrong Siddeley Viper, the Jindivik has near-sonic performance and carries camera pods on its wing tips which record the miss-distance of the missiles fired at it. Designed and built in Australia, these targets are also to be made by East Coast Aeronautics, Inc., of New York State. Sweden is a recent customer.

In flight in the upper view is a Mk 1 Jindivik, which was powered by the Armstrong Siddeley Adder. (Centre left) Another type of long-range ciné camera for flight-recording. The targets are also tracked by radar. (Centre right) A Jindivik pilot, at the monitoring point near the take-off strip, wears headset and microphone for communication with the launching-point (lower right), where an operator controls the fuelling and charging processes. (Lower left) After each sortie a Jindivik has a boomerang stencilled on its fin; stars of various sizes are added to indicate interceptions by various types of missile. For routine test purposes, the missiles are operated without their warheads.

HANDLING THE AGRICOLA

Austers' New Agricultural Aircraft

By C. M. LAMBERT

WHEN I came to fly the Auster Agricola at Rearsby last week, I spent most of the flight in close formation with the Auster Aiglet Trainer demonstrator while air-to-air photographs were being taken. This experience of formation flying after only a few minutes in the air alone really impressed me. The aircraft was stable but responsive, easy to handle and practically free from trim changes. I dropped five hundredweight of pelleted fertilizer across the airfield in a matter of seconds at 70 m.p.h. and could trace no trim or control changes during that time. After one and a half hours in the air I was completely confident of the machine and not at all fatigued.

The Agricola is an agricultural aircraft in the best sense of the term. Great care has been taken to make it simple to fly and to operate, with particular emphasis on accessibility for maintenance and resistance to corrosive chemicals used in spraying or dusting. The "un-Austerly" appearance of the machine is ample testimony to the company's entirely new approach to the design, and special attention to operational requirements is evident in every component. The individual features can be gleaned from *Flight's* detailed description which appeared on January 13 last. The Air Registration Board has thoroughly evaluated the Agricola and the accompanying performance figures are those checked by its pilots. The first prototype, ZK-BMI, which I flew, has now completed some 130 hours' flying with the minimum of maintenance and is still in excellent shape. Corrosive fertilizer dust has been allowed to get into it and has not been cleaned out. The special protective paint finish inside and out has shown no signs of deterioration. A considerable quantity of fertilizer has been loaded and dropped or jettisoned and everything works smoothly and effortlessly.

Advantages of the Agricola include good spray distribution in the wing wake, easy access to spray tanks (total capacity 144 Imp. gal) in the wings, easy refuelling, wide track undercarriage (14.33ft) and easy access to the hopper filling-neck. During hopper loading, with the engine running, the pilot is protected by the closed and sealed canopy. Toughened glass windscreen panels are not scratched or clouded by dust, and flat plastic side panels are all easy to replace or repair. The hopper load is located below and behind the pilot; and freight, or two rearward-facing passengers, can be carried in a cabin behind it. A strong cockpit structure protects the pilot in case of accident and the seat is mounted directly on the wing centre-section. There is a strong four-point adjustable seat harness.

"Flight" photograph

From the pilot's seat visibility in all directions except directly rearwards is excellent. The engine cowling is flat and slopes sharply downwards. There is plenty of room and seat and posture are comfortable. All controls except windscreen wiper and rudder pedal adjustment are close to the left hand, and well designed. The hopper aperture can be precisely controlled without effort and jettisoning is rapid and simple. The flaps have two positions. When fully down, hinged trailing edges deflect from the main flap to give high drag. A mechanical follow-up linkage gives a precise position indication. Hopper and flap controls are hydraulic, relieving the pilot of any heavy hand loads which might be irksome or tricky close to the ground. Both can be operated by sense of touch alone. There are no electrics and no battery, for safety reasons, and engine starting is by standard external power source. A motor lorry battery at half charge is quite sufficient.

Engine starting is simple. Fuel pressure is raised by a well-located and efficient hand-pump; the engine is primed by Ki-Gass pump, and both magneto switches are turned on. Following Continental tradition, the mixture lever is placed in the idle cut-off position for starting and, as soon as the engine catches after the starter button has been pressed, full rich mixture is selected.

Taxying is most satisfying. Visibility is superb, and the tail-wheel is precisely steered from the rudder pedals. Steering can be overridden when required for really sharp turns. The hydraulic brakes, operated individually by tilting the rudder pedals, are not very strong or sensitive, but perfectly adequate in view of the excellent tailwheel control. They will hold full engine power.

For take-off the standard R.A.F. vital actions for piston-engined aircraft once again proved entirely adequate: elevator trim was set at neutral. Having run through the mnemonic, I opened the throttle smoothly to full power. Noise level in fine pitch was fairly high, but vibration was very low. Acceleration was excellent, the tail came up easily and the Agricola flew off cleanly after only about 50 yd run. Speed built up very rapidly from about 40 m.p.h. at unsticking and the climb was very steep. This speaks well for agricultural performance. Good control was immediately apparent, the machine being steady, but very responsive. Particularly remarkable was the high rate of roll attainable with the exceptionally long, slotted ailerons. The rudder was quite sufficiently effective for all normal purposes, though no great degree of sideslip could be obtained at low speeds, with power off and take-off flap down. The feel of the rudder was, however, excellent and the directional effects of throttle variation or full power on take-off were negligible. The Continental 240 h.p. engine is inclined sideways and downwards by a few degrees with this end in view.

Lateral stability was effectively neutral, and displacement in the longitudinal axis from the trimmed, clean, cruising flight condition resulted in one fairly pronounced oscillation with a positive and quick return to the trimmed attitude. The elevator trim was high-geared and very positive in its effect. In no condition did I run out of trim and at no time did I have to turn the trim wheel more than a third of a turn from the neutral position. At about 50 m.p.h. I trimmed for hands-off flight with the nose well up in the air. Application of right rudder caused the nose to rise and left rudder made it yaw to the left and fall away fairly sharply. At 80 m.p.h., extension of one-third flap gave a nose-up trim change which was cancelled out when full flap was selected. This latter setting gave a pronounced increase in drag which should be very useful for short-field operation. Cutting the engine during the final approach produced neither trim change nor noticeable sink. For the round-out there was plenty of elevator control and the aircraft could be stalled on or landed tailwheel first without difficulty. A smooth three-pointer was very easy to achieve and the big low-pressure tyres, wide undercarriage track and good shock absorbers made touchdown smooth and free from any tendency to bounce.

The ride when taxying was smooth and very steady for the same reasons. The rudder pedals have been made specially large to accommodate any footgear up to and even greater than Wellington boot size. The heels are firmly supported, foot straps prevent the feet slipping or lifting off, and the axis of tilting is so placed that there is no tendency to slide off the pedal when braking hard.

The Agricola in rural setting, left, and, on the next page, above the seasonal mist. The braking surfaces on the flap trailing edges and hopper doors are clearly visible in the view from the ground.

"Flight" photograph

The pedals do not have to be tilted too far forward, so that a tightly laced ankle would not be chafed during constant braking.

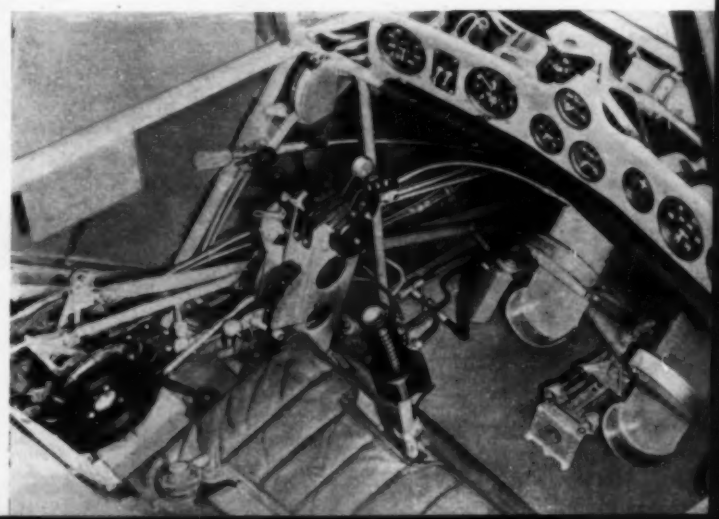
One characteristic I did notice was an apparent elevator overbalance at low speed with take-off flap. Though this was a little disconcerting at first, it was not dangerous or difficult to deal with; and it has been proved that the characteristic is not divergent. The c.g. has been moved progressively aft in the full load condition back to 35 per cent of the wing cord aft of datum. Flying trimmed for 50 m.p.h. with 2,300 r.p.m. and −5 lb intake pressure, no adverse effects were found by A.R.B. pilots. It is thought that shielding of the elevator horn balance by the tailplane may be the cause. Austers have achieved very commendable load-carrying capability in the Agricola. The maximum useful load is no less than 38 per cent of the gross weight at present authorized.

After a ten-minute flight to get the feel of the machine, I landed and taxied up to a loading hopper suspended from a boom on the control tower. While I sat snugly in the closed cockpit, five hundredweight of pelleted fertilizer was dropped with a roar into the hopper through the permanently open circular hatch in the roof just behind my head. On take-off I could feel that I was carrying extra weight, but the flying characteristics seemed to be exactly the same, with high manœuvrability still available. I made a dummy run at 70 m.p.h., at 20ft, with take-off flap and a fair amount of power. Having ascertained that this would satisfy the photographer on the ground, I made the live run in the same way and opened the hopper doors to start dusting. As the fertilizer left I could feel no change at all in trim or control. The whole quantity was gone in seconds and I climbed steeply away after selecting "jettison" to make sure that it was all gone. A certain amount of dust percolated into the cabin during dusting, but this was because the prototype hopper is not fully sealed. In production aircraft, of course, the hopper is lined with glass-cloth and completely sealed off from the rest of the airframe. All parts of the Agricola are either sealed or protectively coated against corrosion.

Because of dusting and photographic commitments during my flight, I had no time to try stalling the Agricola. During one landing, however, I did stall it about one foot off the ground. I first realized this when the wing dropped and one mainwheel touched down before the other. There was apparently no aerodynamic warning of the stall and full control remained up to the last moment. An expedient finally chosen by Auster to provide stall-warning is the American Safe Flight Instrument Corporation's stall warning device with a stick-shaker, but this was not fitted in the prototype when I flew it. Speed dropped off very quickly when I closed the throttle and extended take-off flap, but the two A.S.I.s, set high up at each end of the wide, shallow instrument panel, could be easily watched with the minimum eye movement. The stalling speed is in any case very low, and dusting operations would normally be carried out at speeds comfortably above that of the stall. After peeling off from the photographic aircraft I held a steep turn with the stick well back and found that I could pull quite a creditable amount of g without any sign at all of a stall or flick. During a series of peel-offs I was most pleasantly surprised by the Agricola's very high rate of roll.

At the time of my flight, the third production Agricola was being dismantled in the final assembly bay for packing and dispatch to New Zealand. Major components of the fourth were ready to take its place and further machines are to follow at short intervals.

Leading data at 3,675 lb gross weight (*bracketed figures denote "no payload"*).—Span, 42ft; length, 28.07ft; unstick distance in 5 kt wind, 185 yd (55 yd); distance to clear 50ft in 5 kt wind, 440 yd (160 yd); initial rate of climb, 610ft/min (1,310ft/min); service ceiling, 10,500ft (20,000ft); max. speed at 1,000ft, 127 m.p.h. (136 m.p.h.); max. cruise at 1,000ft, 123 m.p.h. (132 m.p.h.); economic cruise at 1,000ft, 101 m.p.h. (115 m.p.h.); range at economic cruise, 218 miles (240 miles); stalling speed (flaps down, power off), 44 m.p.h. I.A.S. (35 m.p.h. I.A.S.); distance to land from 50ft (5 kt wind), 380 yd (245 yd); distance to land from 20ft (5 kt wind), 315 yd (205 yd); landing run, 145 yd (90 yd).

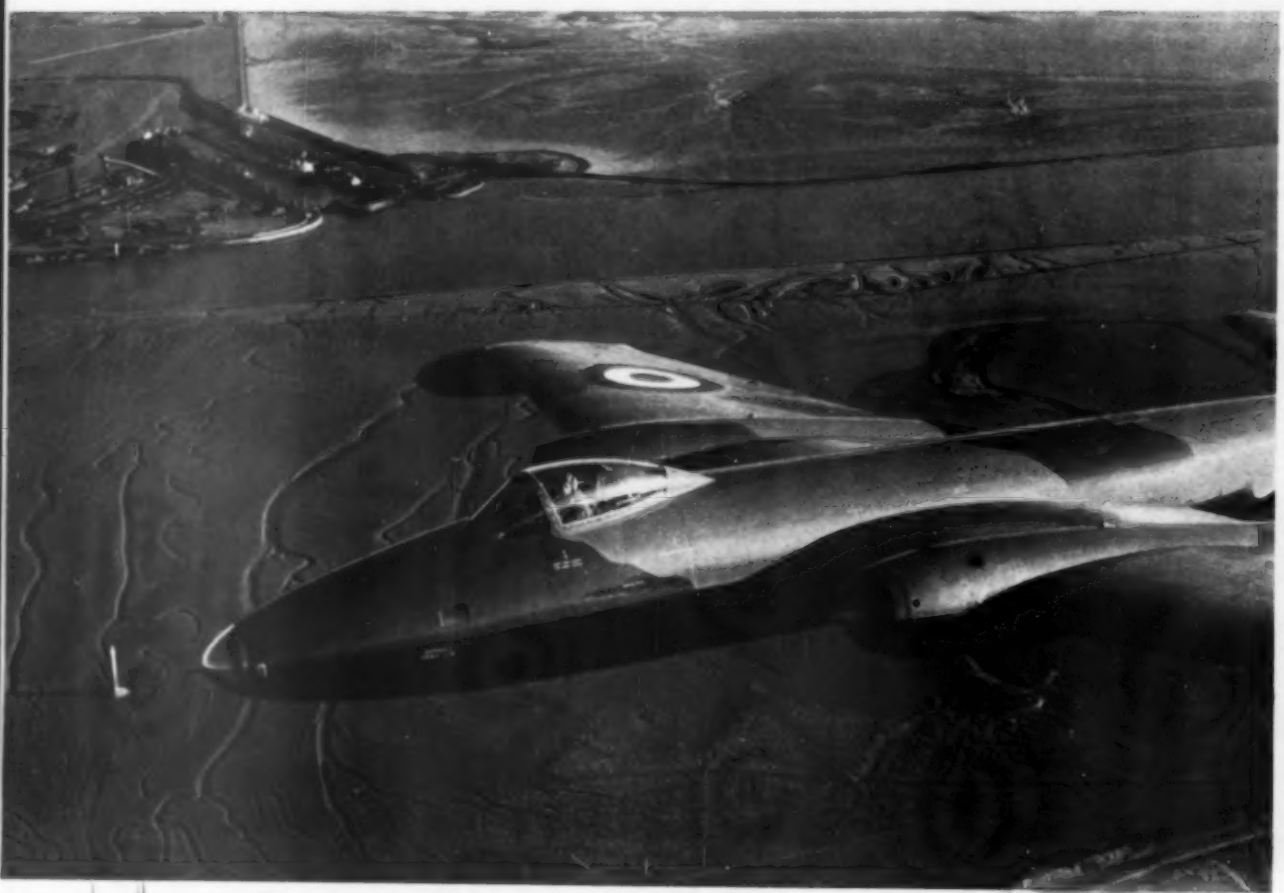


The business side of the Agricola's spacious cockpit. The levers on and beside the throttle quadrant are, from left to right, carburettor heat, hopper opening, throttle, mixture and pitch controls. Below them are the flap lever and indicator and parking brake. Aft of these are the hand-operated fuel-pump and trim wheel. Instruments, magneto switches and E.2A compass are disposed on the shallow instrument panel.

648-649
FLIGHT,
19 *October*
1956

P.R.9, B(I).8, P.1

NEW and future R.A.F. equipment by English Electric is represented in these recent pictures. Above is a *Flight* photograph of a Canberra P.R.9 ultra-high-altitude photographic reconnaissance aircraft, powered by two Rolls-Royce Avons and capable of flying at over 60,000ft. Immediately below and on the right are remarkable studies, by English Electric chief photographer E. Kitchener, of the Canberra B(I).8 bomber/intruder as now serving with 2nd T.A.F. The curious landscape seen in the picture below is that of the Walney Island, near Barrow-in-Furness. Last—in another picture by Mr. Kitchener—is the P.1 prototype WG760, powered by two Armstrong Siddeley Sapphires.



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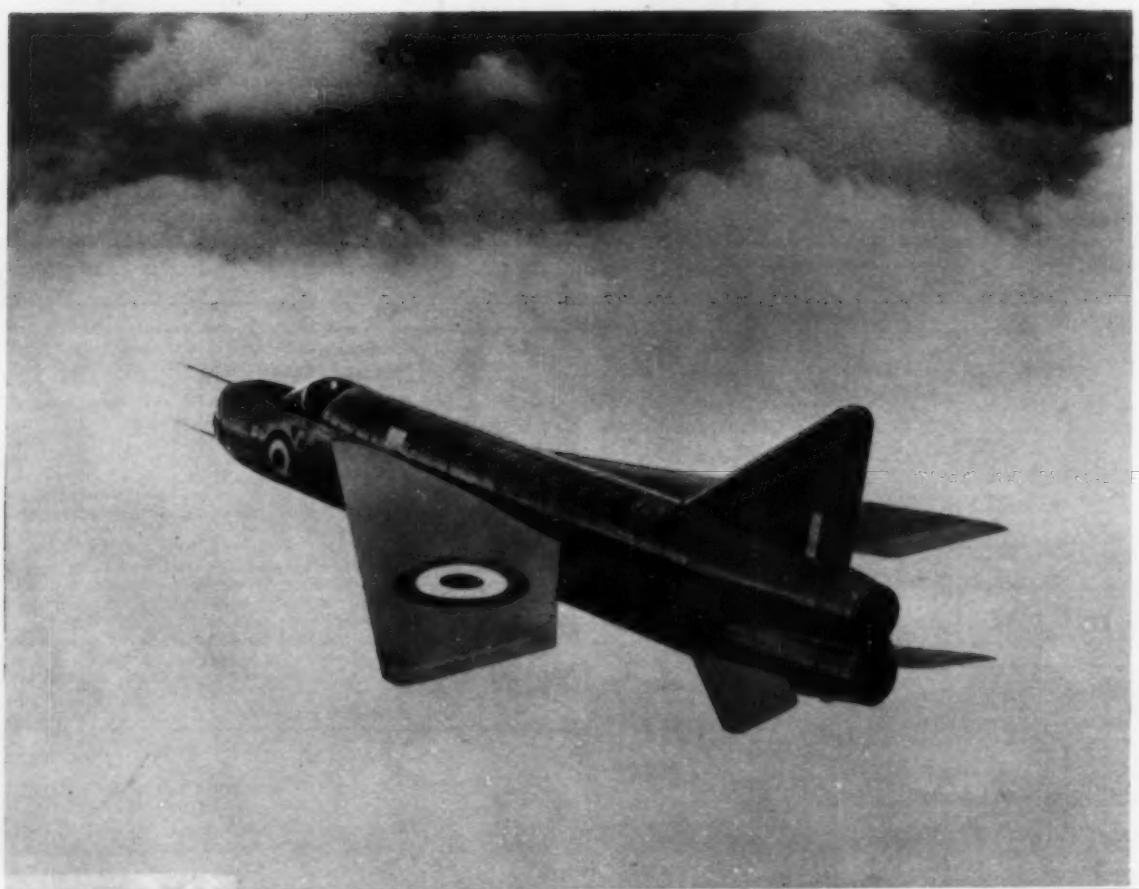
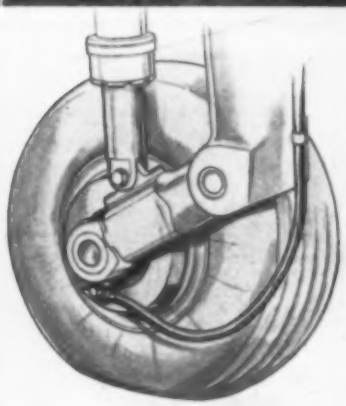


Better Braking for Miles Geminis

Palmer Disc Installation: "Flight" Staff Aircraft Converted



The neat, unobtrusive installation as it appears on a Gemini mainwheel.

A DISADVANTAGE of the otherwise entirely admirable version of the Miles Gemini with Gipsy Major engines is that the small Bendix brakes, already rather overtaxed by the weight of the standard aircraft, are less than adequate for stopping or running-up the heavier Gipsy-Gemini, even on dry tarmac—a deficiency that the higher residual thrust at tick-over speed of the more powerful engines does nothing to relieve.

The fact that only a comparatively small number of converted Gemini aircraft are in use was, it seemed, an obstacle to obtaining the assistance of a brake manufacturer to remedy this situation—until a chance conversation between Air Couriers of Croydon and a Palmer tyre engineer resulted in the problem being brought to the notice of The Palmer Tyre, Ltd. They were immediately sympathetic and, after a preliminary investigation, enthusiastic that a solution could be found. Inevitably, whatever design of disc brake—the obvious choice—was adopted, a low-pressure closed-circuit hydraulic system would be required. Palmer had previous experience of this type from a Provost installation.

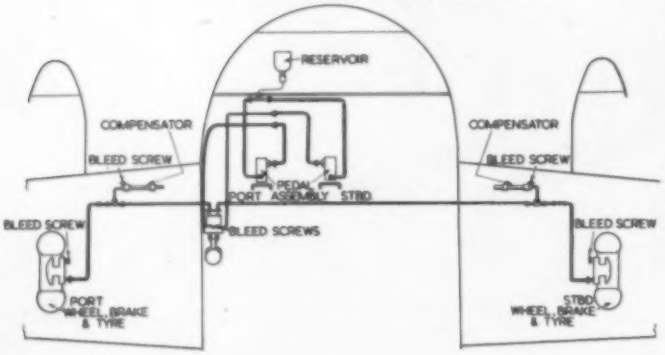
In practice, a considerable amount of modification was required to the various components that Palmer had available to suit the Gemini installation, but this was tackled with the determination to make good the previous deficiency. The mainwheel is an adaptation of a type designed for use on a helicopter, and may be fitted directly on to the Gemini stub axle. The only undercarriage modification required is the replacement of the taper pin which transmits the torque from the brake disc into the axle by another pin of a larger size—testimony of the very greatly increased braking power available.

An annular-piston disc brake—of exceptionally neat design—has been adopted to make the best use of the fluid pressure that is generated in the master cylinders, and a special anti-fade high-working-temperature lining has been developed and supplied by Ferodo. The annular-disc piston—contained within a housing in the forged light-alloy main frame of the brake—bears against a pressure plate registered in slots in the brake carrier which forms the inner part of the assembly and is bolted to the main frame. The brake disc is driven by slots in the main wheel, within which it is located. The wheel and brake assembly carry six-ply, heavy-tread 6.00×6½in tyres of Palmer design.

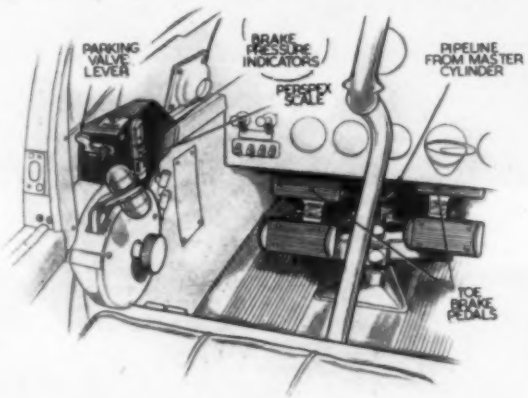
Installation of the new braking system was undertaken in the Croydon workshops of Air Couriers, who successfully modified (from schematic drawings supplied by Palmer) Mr. Ken MacAlpine's Gipsy-Gemini before undertaking conversion of the *Flight* aircraft—a task that was not an entirely simple repeat operation, as some additional modification had to be made to clear the starboard (dual) rudder bar with which our Gemini is fitted.

The brake pedals, which are of the toe-operated type, are Palmer adaptations of the Provost pedal and are connected to the twin hydraulic master cylinders *via* short push-rods. A vented reservoir is mounted on the nose bulkhead, where it is accessible for filling and priming the system through the luggage compartment in the extreme nose (an operation that may be performed from the head provided by a gallon can held over the nose of the fuselage). The remaining components of the system are a pair of thermal pressure-compensator units—mounted on the wing spar and accessible through the detachable inner leading edge—and a parking valve and pressure indicator in the cockpit. Hydraulic lines between each unit are of hard Tungum pipe and Palmer Silvoflex high-pressure flexible hose. The parking valve, which is essentially a double spring-loaded non-return valve, is tripped by a lever on the valve block; repeated toe pressure on the pedals then builds up and sustains hydraulic pressure on the brake pistons. This pressure is reflected in the pressure-compensating units, which are disc-spring-loaded to crack at 130 lb/sq in and thereafter create a "reservoir" for excess oil. Variations in selected brake pressure resulting from temperature changes are absorbed in this variable capacity. The ends of the operating piston are attached to a length of piano wire which runs in a conduit and terminates at the cockpit indicator—a Perspex block with coloured divisions to indicate the system pressure (the fluid is hydraulic oil D.T.D.585). The indicator (an Air Couriers adaptation of the Palmer pressure-indication method) provides the pilot with a simple and effective check upon the brake effectiveness, since, with the parking lever applied, the pressure generated in each brake can be read off against the indicator scale.

Schematic diagram of the installation.



In operation, the brakes are effective and reasonably progressive. Differential operation (which may, of course, be assisted with the throttles) is independent of rudder-bar position and is applied with one pedal only or by a greater load on one pedal than the other. The design of the brake ensures that no snatch occurs when maximum application of one brake is made while taxying at a brisk walking pace; but heavy braking requires high pedal-loads, which tend to discourage rough handling. Manœuvring the Gemini on the ground has become the simple and straightforward operation that the private pilot welcomes.



Brake details in the cockpit of the "Flight" Gemini. The installation is confined to the port pedals.

For running up, the parking lever is set and the pedals pumped twice until the indicator rods reach the division below the junction of the blue and red segments of the scale. This mark corresponds to a pressure of about 150 lb/sq in applied to the brake pistons and is sufficient to hold the aircraft at full throttle on one engine or both. More pressure may be obtained by some hard pumping on the pedals, but the increasing foot loads and the five- or ten-second delay that occurs while the rather sluggish master cylinders recover will in practice generally limit the pressure applied to a little more than the minimum necessary for run-up. This pressure, in any case, has been selected as a mean, about which diurnal temperature variations will not reduce the effectiveness of the brakes when the aircraft is parked.

Providing the Gemini with brakes has been the result not of a shopping expedition but an unusual and heart-warming degree of co-operation and enthusiasm by a leading manufacturer and some keen installation engineers. Brochure preambles and advertising slogans can only infrequently be relied upon to give a realistic appraisal of a manufacturer's attitude to a project where commercial gain is unlikely to be guaranteed; but the first two satisfied customers are inclined to subscribe to the declared aim that "Palmers are interested in any problem whose solution may advance aviation, and gladly offer the services of their development organization for work on it."

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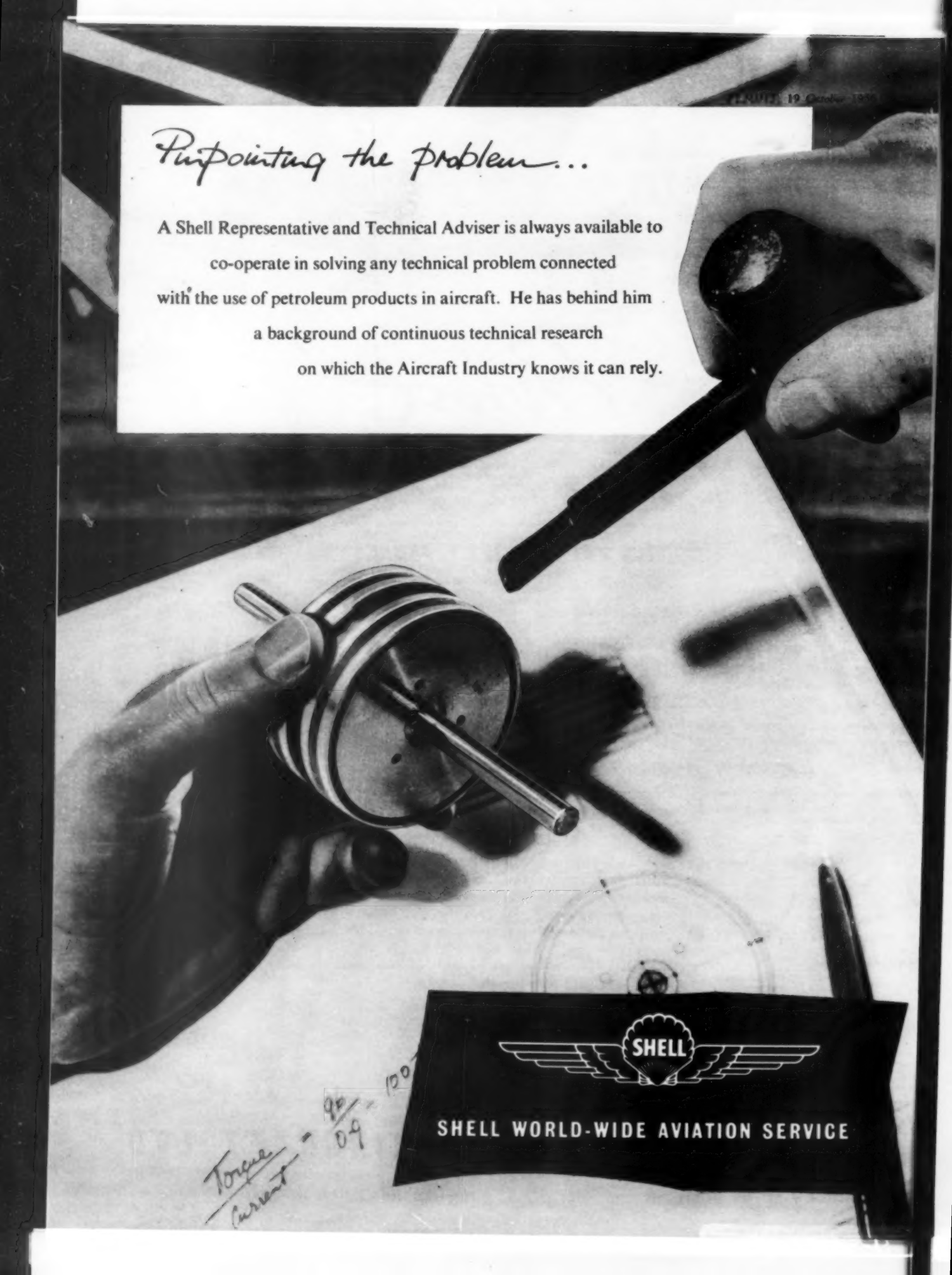
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Strain-gauging Helicopter Rotors

Saunders-Roe Electronics Specialist Describes Pre-amplification Technique

AT the first meeting of the Helicopter Association's 1956-57 lecture programme, held at the Royal Aeronautical Society on October 5, a paper entitled *Strain Gauge and Blade Motion Recording Systems for Helicopters* was presented by Mr. P. D. MacMahon, electronics engineer with Saunders-Roe, Ltd. Dr. G. S. Hislop was in the chair.

Mr. MacMahon began by outlining the problems specifically associated with rotating-wing-aircraft instrumentation and reviewing some of the present methods of recording strain-gauge and blade-motion signals. The problems that had to be dealt with concerned:—

(a) Magnitude, nature and distribution of stresses in rotor blades.
(b) Dynamic geometry of blades about their hinges, which required full distribution of typical cycles.
(c) Stresses in rotating mechanisms: for example, control and power-distribution linkages.
(d) Structural vibration.
(e) Cyclic stresses fed back into pilot's or other control linkages.
(f) Torsional vibrations associated with rotor drives and other power-transmitting shafts.

Present helicopter instrumentation techniques were based almost entirely on those developed for fixed-wing aircraft of the last 20 or 30 years. This necessitated equipment modification and adaptation to a greater or lesser degree, and it was his contention that these methods were not an entirely satisfactory solution to the problem. It was essential to recognize that a very different range of problems was met and, while the aircraft type of instrumentation could be made to yield answers, these were not often in a convenient form. Furthermore, a great deal of uneconomical labour was required to bring into prominence data which it should be the fundamental design-task of the instruments in use to provide.

The problem of recording steady stresses (which normally changed only with change of flight conditions) simultaneously with dynamic stress was particularly difficult in helicopter work. This was because the fatigue-inducing vibratory stresses were not usually very large in comparison with the loads which induced steady stress. Consequently, for any given recording field a choice had to be made between accurate recording either of relatively low-amplitude high-frequency detail or of large-amplitude static detail. Until recently it had not been possible to do both satisfactorily at the same time.

Signal amplitudes rarely exceeded a few millivolts and signal-frequency band-width was from approximately 2 c.p.s. to about 300 c.p.s. The lower figure corresponded to a once-per-rev phenomenon at 120 rotor r.p.m.; the higher corresponded to possible excitation due to engine vibration harmonic orders at average engine speed. In general, it could be said that direct current was preferable to alternating current for energizing the strain gauges. Recording could be by mirror galvanometers to photographic film or paper or, alternatively, to magnetic tape. The last-mentioned would undoubtedly be used widely in the future when current development work had improved the method.

It was not practical, except with certain limitations, to drive the mirror galvanometers direct from the strain-gauges, and electronic amplification of the signals was therefore necessary. Apart from conventional forms of amplifier, two newer types, the magnetic amplifier and the transistorized amplifier, were worthy of consideration for use in the future. They could be used to great advantage where miniaturization techniques were desirable, but more experience was needed with them before they could be applied satisfactorily to work on helicopters.

As far as the recording of rotor blade movements was concerned, amplification of signals was not necessary, since for this work the strain-gauges were replaced by high-accuracy linear potentiometers. Energizing voltage for the potentiometers was obtained from the H.T. supply, *via* suitable dropping resistors, and connections from the potentiometers were made direct to the turret. The angular displacements of cyclic-pitch change and blade flapping to be measured were generally of the order of several degrees. Therefore, the angular resolution obtained from commercially available toroidal-wound potentiometers of plus or minus ½ deg was adequate. It was not adequate, however, for motion of the blade about the drag hinge—the "niggling" present at the blade root in a cruising flight condition—and accuracy had to be improved by step-up gearing in the mechanical linkage between the blade root and the potentiometer. Care was necessary in the design of the step-up gearing, in order to avoid any fundamental resonance excitation in the mechanism.

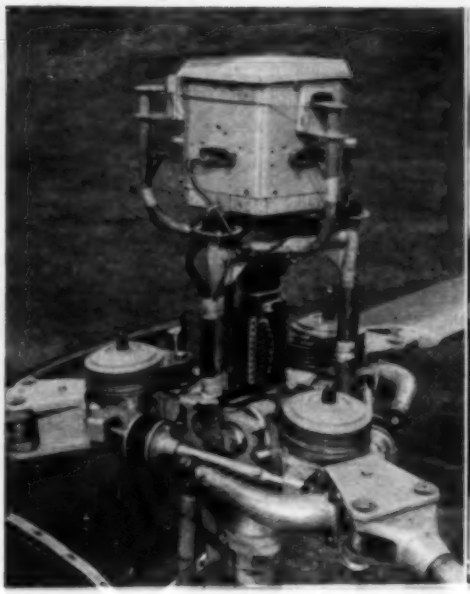
The lecturer then gave a detailed description of recording equipment. There were available a number of different galvanometer cameras, such as those of Miller, de Havilland and Savage and Parsons. Confluent pulse techniques were exemplified commercially in the Elliott-Yates ten-channel display equipment, while telemetry was an exceptionally promising method for the future—particularly so when the vast amount of experience now being accumulated in guided-weapon establishments became more generally available. The Mervyn system of data recording and analysis, in which use was made of magnetic tape as the transfer medium, was another equipment of great value to the research engineer.

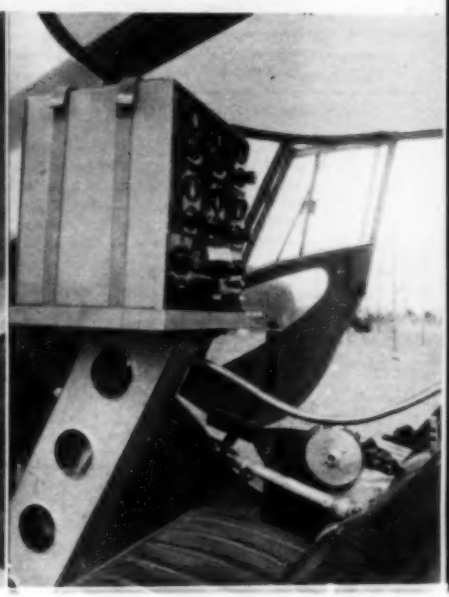
Mr. MacMahon went on to describe the lightweight six-channel equipment designed and produced by Saunders-Roe specifically for helicopter application. The original proposals for the equipment had been made to the Ministry of Supply in 1953 and a design target of 70 lb all-up weight had been set so that the equipment could be used in the smallest helicopters. To avoid the practical difficulties associated with the use of slip-rings at low signal levels it had been decided that pre-amplifiers should be mounted on the rotor head. The relatively high signal output would then be passed through slip-rings to a panoramic display unit in the cockpit below.

The display unit was to provide a visual assessment of the oscillatory stress characteristics with complete control of signal level by individual attenuating facilities for each of the six channels. The signals were to be recorded in a small multi-galvanometer camera.

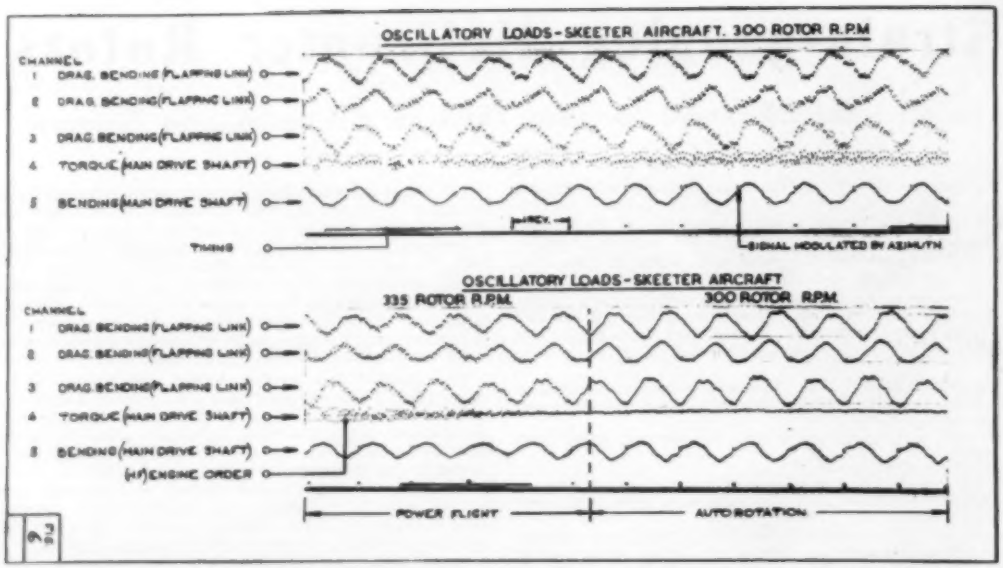
Steady state stresses were to be measured by reference to a wide-sweep galvanometer mounted in the display unit, the signals feeding this galvanometer being proportional to the unbalance present in the pre-amplifiers which, in turn, would be directly related to the strain-gauge bridge or transducer connected to it. Attenuating facilities would also be incorporated. Power supplies were to be derived from a three-phase 400 c.p.s. rotary inverter running off the aircraft 24-volt system, each phase of 115 volts A.C. being stepped up or down by transformers to provide regulated, unregulated and e.h.t. voltage.

Excitation of the strain-gauge bridges (or other transducers) and the pre-amplifier heaters was to be by means of a Venner accumulator, the lightweight, small bulk and straight-line discharge characteristics of which were eminently suitable for the purpose. The accumulator was to be housed in the pre-amplifier structure





(Left) The pre-amplifier mounted above the rotor head of the Skeeter. (Right) The panoramic display unit, installed on a structure in the cockpit in front of the flight observer's position



A typical record made with the Saunders-Roe equipment. Reduction of the high-frequency engine vibration is particularly noticeable in the autorotative condition.

STRAIN-GAUGING HELICOPTER ROTORS . . .

itself, mounted on the rotor head, to reduce the number of slip-rings required.

The equipment was completed in June 1954 and was thereupon subjected to a test programme on the company's rotor test tower at Eastleigh. The pre-amplifier had comprised the most exacting part of the design. Drift from D.C. amplifiers had been an inevitable problem to be faced and a figure of 1 millivolt per half-hour was aimed at and had eventually been achieved. This was the equivalent to a stress (Dural) of 1,000 lb/sq in when using Saunders-Roe strain-gauges excited with 12 volts D.C. The final choice of valve for the pre-amplifier was a "ruggedised" version of the VX.7117.

As a result of experience gained on the rotor test tower, a number of modifications were incorporated to improve the accuracy and reliability of the equipment and the first flight test on the Skeeter Mk 5 helicopter was made in September 1955. Since that time a total of 46 flights had been made, 35 of which had provided full and acceptable stress recordings. A further series of tests was carried out in April 1956 on the Skeeter Mk 6 helicopter and as a result of the comprehensive analysis of the recordings made with both machines the company had now obtained clearance for employment of the equipment in the Skeeter 6 flight strain-gauging programme.

It appeared that the utilization of the equipment was likely to be considerable in the future as it would also be needed for the sustained testing of the bonded-metal rotor blades, now under development, both on the rotor test tower and on the actual machine.

The lecturer concluded by giving a number of technical details appertaining to the various individual components in the equipment. He said that the method of amplifying relatively small signals with thermionic valves and passing the amplified signals in a voltage form had proved itself not only practical but superior to direct recording systems at present in use in the United Kingdom and on the Continent. Maintenance requirements were average, bearing in mind the complex nature of the equipment; but the fact that strain-gauge and blade motion calibrations were directly made dispensed with the hazards of calculated errors and rendered analysis of oscillatory and steady stress quantities simpler and quicker. In his opinion, the new equipment represented a major step forward in helicopter stress-measuring techniques.

DATA ON COMPONENTS OF SAUNDERS-ROE EQUIPMENT

Component	Weight (lb oz)	Location	Dimensions (in)
Pre-amplifier and mounting ...	10 2	Rotor head	10 x 10 x 7½
Monitor unit and pedestal ...	22 8	Cockpit fwd.	12 x 12 x 11
Three-phase power unit ...	9 3	Cockpit aft	15 x 10 x 3
24-volt power unit	20 5	Airframe aft	9 x 9 x 8½
Vannar batteries box	9 4	Cockpit aft	6½ x 8 x 6½
SFIM recorder	4 6	Cockpit aft	6½ x 8½ x 4

Total weight, 75 lb 12 oz. Additional component for static use: calibrator unit.

THE DISCUSSION

Mr. R. Trumper (Fairey Aviation) congratulated the lecturer on his paper and said it was interesting to note how close were the views of the two companies as regards the best future trends in stress measuring techniques, particularly in respect of the potential value of the magnetic tape recorder. However, as far as present equipment was concerned, he thought his own company's method, based on many year's airscrew strain-gauging experience, was far simpler. They did not use any pre-amplification of signal but connected the strain-gauges direct to the slip-rings. The results obtained had always been satisfactory. The equipment was pre-set before flight and they preferred the possibility of an occasional wasted flight to the added complexity of pre-amplification and monitoring. Mr. Trumper gave a brief description of the Fairey equipment, the total weight of which was 57 lb.

Mr. A. F. Appleton (Bristol Aircraft) outlined his company's experience with strain-gauging equipment, saying that they had never had to consider the possibility of using pre-amplification to strengthen the signal before connection to the slip-rings. Their equipment was similar to that of Faireys. Mr. Appleton said later, in defence of Mr. MacMahon, that if a slip-ring problem was encountered in connection with low-level stresses, the use of pre-amplification was a sound engineering approach to its solution. He would like to see a freer exchange of problems by instrumentation engineers, especially at the start of any particular job.

Mr. F. N. R. Ballan (Westland Aircraft) agreed with the two previous speakers that pre-amplification introduced unnecessary complexity into strain-gauging techniques. They had begun with little knowledge and simple slip-ring equipment and had gradually improved their efficiency with experience. They could now achieve a recording accuracy of 5 per cent, which he thought was perfectly adequate. He wondered why the lecturer attached so much importance to attaining high accuracy in the measurement of low-level stresses.

Mr. K. G. Dobson (Mervyn Instruments) gave a brief account of the operation of the Mervyn recording and analysis system. He said that the system performed a full and complete automatic analysis of all the information in the wave form with far greater speed and accuracy than by mechanical measurement. One analyser could be used in conjunction with a number of separate recording units which could be set up for different types of work by various departments in a large company. It had been his experience that many of the other established methods of analysing data had been developed because no facility for complete analysis had previously existed.

Mr. J. S. Shapiro (consulting engineer) thought that too much analysis could be misleading. Knowledge of fatigue was based on a number of repetitions, and unless harmonic analysis gave analysis into harmonics and phase relations the result was misleading. This was most important with second and third harmonics and in blade stressing.

Mr. C. E. P. Jackson (Westland) asked whether the lecturer had had any experience of measuring tail-rotor stresses and expressed the opinion that the use of pre-amplification in this case would not be possible.

Mr. MacMahon, in reply to the discussion, stoutly defended the case for pre-amplification of signals. How could one be sure, he asked, that supposed low-level stresses were in fact low-level until they had been measured accurately? He was grateful to Mr. Trumper for his contribution which, he said, gave much food for thought. In general, however, he considered the individual attenuation facilities were a desirable feature to reduce the number of test flights required to obtain satisfactory results, in spite of increased complexity of equipment. The greatest advantage of the Mervyn system was in its speed of analysis. He had not had experience of tail-rotor stress measurement but agreed that obviously the use of a pre-amplifier would not be suitable.

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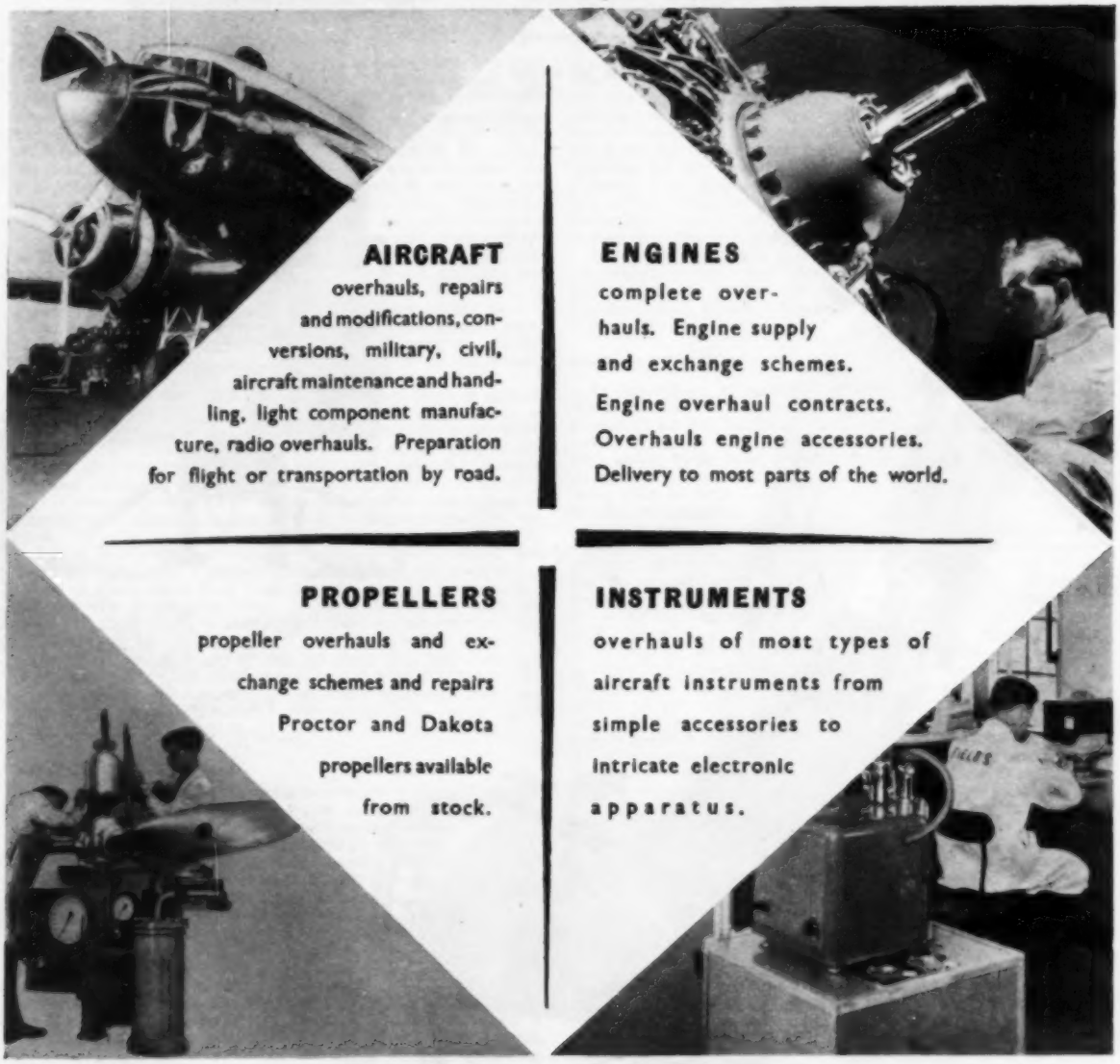

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MARTIN-BAKER AIRCRAFT COMPANY LIMITED

ENGLAND —— CANADA

CONTROLLING THE TRAFFIC

Postscript to the Southend Convention

IN last week's issue we published a summary of the Guild of Air Traffic Control Officers' disquieting report on Britain's air traffic control system. We summarize here the other papers and discussions, to which only brief reference could be made in last week's issue.

The Master of the Guild, MR. E. VINCENT MILLER, observed in his opening address that radar, invented in war to get aircraft into close proximity, was, in peace, the key factor in keeping them apart. It was encouraging to see the British electronic industry's progress, whose heavy costs should be remembered. It was imperative to have first-rate aids—given them, the controllers would do the job.

The first paper, giving the civil pilot's point of view, was read by CAPTAIN H. C. BAILEY, a senior B.E.A. Viscount captain. He spoke of the sort of problem that the "chap in the tower" perhaps did not always fully appreciate. How, for instance, when the pilot asks for 25,000ft, he "really needs it"; every 1,000ft reduction for the same speed cost, in a Viscount, 80 gal/hr. He cited a recent experience at one airport, where he asked for a 22,500ft clearance, got 16,500ft over beacon A, and was later asked to change to 14,500ft over B—20 miles away. Finally he was told to go back to A. On another day he used 23 minutes of fuel on similar "dead flying." It was, he said, very difficult to keep a look-out during V.F.R. flying. Not only was visibility "very restricted," especially in the normal seated position, but there was too much to do besides watching for the "odd R.A.F. jet darting from one side of the airway to the other." There was, for instance, Decca to play with (this took up most of the time), and altitude had constantly to be watched. In the 30 sec it took to check r.p.m. synchronizing, or pressurization, "you could hit a 600 m.p.h. jet."

Half way through his address Capt. Bailey asked if anyone had any questions. These were plentiful and provocative, so much so that at one point the Master had to call for order when the discussion looked like being transferred to the floor of the house. Why wasn't there a tie-up on aircraft scheduling between operator and traffic controller? Others wanted to fly at 25,000ft too. Couldn't runway visual ranges and weather information be supplied on different frequencies? The controllers had enough to do. Capt. Bailey agreed about the "endless yattering" on R/T, and said that it was not policy to listen out, even though this could give the pilot a general picture of what was happening. (More was said about R/T congestion later in the proceedings.) Couldn't the decision to divert be taken in advance from the ground? Capt. Bailey's answer was that, in his opinion, this decision must be made by the pilot. (He made the interesting point that B.E.A. pilots, on an average, make only two diversions per winter.) Did Capt. Bailey consider that advisory routes were a good thing? His negative was strongly supported from the floor of the house. "No one," someone said, "is happy about them."

Descent and Approach

Resuming his address, the speaker referred to the difficulty of getting down quickly. It was very easy in the Viscount to overheat the engines; throttling them back to keep below V_{no}, with the A.S.I. hovering around the 190-200 kt ("my speed, not the experts' ") was manageable provided the pilot had some warning before being asked to descend quickly from 25,000ft to hold over, say, Dunsfold at 7,000ft. He always liked to hold high, not only because fuel consumption was less (the 100 gal reserve, which represented only 20 min anyway at low altitudes, also represented four passengers) but also because passengers were very often bumped about during holding lower down.

It was his experience that London radar could get pilots on to the approach more quickly then they could themselves on V.F.R. Radar operators might disagree, but he had seen it himself. He thought that the three-mile separation on the approach, due to be brought into effect next summer, was "too close."

Referring again to R/T congestion, Capt. Bailey asked for the adoption of standard clearances and pointed out the difficulty of foreign controllers who did not always know English very well, and who were lost "if you did not stick to the patter." There was a round of "hear-hears" from the audience when he suggested that another frequency than the "over-burdened ground control frequency" should be used for pre-take-off radio checks. He pointed out too that met. reports were usually much too fast to take down. Illustrating his previous points about the difficulty of maintaining a good look-out when flying V.F.R., he recalled the occasion when, after seeing a Tiger Moth ahead which he thought was flying *away* from him, he suddenly realized that it was coming at him and that he might have hit it had he not turned when he did.

A further discussion ensued. MR. J. MCDONALD, of London Airport's control staff, asked whether Capt. Bailey considered that the second pilot should be as competent on instrument procedure as the first pilot. Capt. Bailey's reply was indirect, bringing laughter when he said that the first officer should be better in this respect. Asked whether he was concerned if he *knew* that military jets were doing aerobatics on the edge of an airway, he replied "Most perturbed. They think we can see them just because we are on V.F.R." The subject of landing rate was raised again. It was pointed out that this was only speeded up when in "near-minima" conditions, which of course obtained when most aircraft were holding. Capt. Bailey thought that a one-minute rate would not be acceptable to pilots. A small stir was caused at this point by a Decca representative who said that he had recently observed one-minute landing-rates at Calcutta Dum Dum—and in monsoon conditions. There had been 3,500 talk-downs in three and a half months. This drew the inevitable query: "Did you have any accidents?" to which the answer was "No." [Dum Dum has Decca 424].

It appeared from this part of the discussion that no one had yet really decided what constituted a minimum safe distance between aircraft on the approach. ("Why not line them up in formation over Epsom," someone asked, "and bring 'em all in at once?")

Military Control

In his lecture on military air traffic control in the United Kingdom, G/C. F. HUME, Deputy Director of Operations (Navigation) at the Air Ministry, spoke up strongly in favour of computers to enable the controller to accept large numbers of aircraft and to bring them down to the approach at intervals. The analogue computer could accept aircraft at the same height and bring them in at the same rate of descent, but the answer lay in the digital computer which could accept and correlate different heights and descent speeds. In his opinion data transfer systems should be fitted to every aircraft, and also proximity-warning devices. Although G/C. Hume did not say in as many words that he viewed joint military and civil control as the answer to the A.T.C. problem, he said that it was one which could not be solved "by one class of user alone." The discussion opened with a question on this point, and the speaker inferred in his reply that the joint-control concept could be the answer, with provisos. Further points discussed were the desirability of "filtering out" aircraft at different heights from the same radar scopes so that aircraft could only be seen approaching each other when they were at the same altitude; the desirability of having detailed knowledge of the "other chap's job," of having civil liaison officers at military centres, and *vice versa*. MR. I. F. B. WALTERS, controller of ground services in the New Zealand civil aviation administration, reverted to the question of joint control. He drew loud applause when he said that he could not for the life of him see why joint control was not instituted in this country as it had been in New Zealand.

There followed the "Any Question" sessions. There were two panels, one consisting of air traffic control officers and the other of representatives from the electronics industry, each under the adroit chairmanship of Mr. A. H. Narracott, aeronautical correspondent of *The Times*. The controllers' panel, which sat first, comprised Mr. B. F. Collins (Southend), Mr. A. Field (Scottish centre, M.T.C.A.), Mr. H. S. Rigby (experimental unit, M.T.C.A.), Mr. K. I. Pearson (R.A.E. Farnborough), Mr. R. Shipley (R.A.F. West Raynham), and Lt. Cdr. Mogg (Royal Navy).

The first question concerned the degree of longitudinal separation achievable by Decca Navigator-equipped aircraft. MR. COLLINS' reply ("12 seconds between aircraft with buffers") seemed to express the feelings generally held on the potentialities of the Decca Navigator. Was not approach control becoming obsolete? It was, MR. FIELD said, rapidly reaching that stage: there was little time to spare to put aircraft from central control over to approach control. The panel was asked for its views on the fact that one aerodrome with 2,000 aircraft movements a month had four controllers, whereas another less busy airport had 20 controllers with 12 assistants. What was the margin between parsimony and extravagance? The panel felt that the number of movements was no yardstick. *[cont. overleaf*

CONTROLLING AIR TRAFFIC . . .

A question as to what sort of machinery should be set up to settle the air traffic control problem drew the reply that, as a young Guild, they could not presume to draw up a full policy yet—but they could highlight the problems. Were not controllers getting a "radar-blip-mentality" instead of getting to know more about the captains? The panel agreed with the need for a more personal touch. Did the panel have any special thoughts on radar-scope presentation? The reply indicated the "luxury" of 15in-size tubes, and stressed the desirability of large presentation. A way was needed for differentiating heights, and for taking out "the slice of airspace you don't want." It was felt, too, that radars should be tailor-made to particular airports.

The "trade" panel consisted of Mr. J. S. King (Sperry Gyroscopes), Mr. H. H. R. Capes (Decca Navigator), Mr. R. F. Hansford (Decca Radar), Mr. M. Settelen (Standard Telephones) and Mr. K. E. Harris (Cossor). The questions came with rapidity, pointed and provocative, and some of them rather basic—for instance: What was the best long range navaid? Dectra, Mr. Capes said, gave track separation, which was the essence of the problem. Standard Telephones H.F. automatic triangulation system, mentioned by Mr. Settelen, could cheaply and simply give bearings up to 1,000 miles when the pilot replies on normal HF/RT. Mr. King of Sperry spoke of the inertial navigation system now being developed, which was completely independent of ground transmission. Mr. Hansford of Decca Radar said that the industry was thinking in terms of integrated systems, to present the controller with the information he wanted simultaneously on one display (as specified in the Guild's report, summarized last week). Yes, someone said, but how? Mr. Settelen was quick to point out that such a system—Tacan—was in use now. Airborne, it transmitted height, heading, position and speed "without the pilot having to do a thing." Presentation "was up to you." But, one speaker said, ground as well as airborne systems were needed.

At several points in the discussion half a dozen members of the audience at a time were on their feet with questions. With one particular question it seems fitting to conclude this review. Should not the users, the trade panel was asked, present to the industry their exact plans of long-term requirements to avoid wastage of technical effort?

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

The Size of an Airline

YOUR correspondent "Noswale" [September 28], who calls for B.E.A. and B.O.A.C. to be amalgamated, bases his argument on three surmises: (1) The Corporations are not as efficient as Silver City Airways; (2) they are not as efficient as certain American airlines; (3) they have duplicated staff, including ground crews.

I am very dubious about the logic of your correspondent's arguments, and would like to consider his three points in turn:—

(1) Silver City is much smaller than B.O.A.C. If it is much more efficient, might not this be partly because it *is* smaller? Some experts have been reported in your columns as suggesting that for greater efficiency B.O.A.C. should be split up. At that rate "Noswale's" suggestion might result in reduced, rather than increased efficiency.

(2) To compare B.O.A.C. with an American line is not just unfair—it is pointless. The American company referred to by your correspondent is there to make money. To do that it buys the best *proved* airliners available, be they Constellations or Viscounts. But B.O.A.C. has many calls on its resources, one of which is to try to develop and use British aircraft. Now our builders of long-range aircraft will be the first to agree that they have had very bad luck in the last ten years. The Tudors, which promised well, had to be withdrawn. The Hermes, though excellent in other respects, proved to be uneconomic. B.O.A.C. geared its whole operational plan to the Comet, which in turn had to be withdrawn. Now it is the Britannia which, by being delayed a year or more from its original planned service date, has upset the Corporation's planning. Even those aircraft which B.O.A.C. has been able to afford in terms of dollars have seldom been fully economic. It is hardly fair to expect an Argonaut to make as much money as its contemporary DC-6, or a second-hand Constellation as much as a Super Constellation. It does not have to be emphasized that each of the setbacks that B.O.A.C. has suffered may have cost millions, and that their present serious shortage of aircraft must cause over-staffing.

(3) Whilst I am not qualified to judge how many staff are duplicated in the Corporations, I do understand that at overseas stations such as Rome, which both of them visit, one of them does the handling for both.

My own suggestion for heightening Corporation efficiency, made in these columns some months ago, was that they be given a free hand to buy the aircraft they think best. But judging by the letters in this journal there is a strong feeling against that policy.

London, W.1. ICARUS.

A "Vintage Aircraft" Memory of 1940

ENCLOSED are four snapshots [one is reproduced here.—Ed.] the subject of which may be of some interest to readers to whom the study of the more historic aircraft forms an intriguing hobby. The aircraft is a Morane-Saulnier 138 and the airfield, at which the following events occurred, is St. Inglevert on the French coast a little to the north of Cap Gris Nez.

During the early months of 1940, "B" Flight, 615 Sqn., of which I was a member, was stationed at the aforementioned airfield, sharing the hangars with a squadron of the French Air Force. In the corner of one of the hangars we found the Morane, dismantled and covered in dust—a forlorn sight indeed. It

The Morane-Saulnier 138 during rebuilding.

nevertheless aroused the active curiosity of several members of the squadron, and I believe the result was that a wager was made with the French pilots that the machine still could, and would, be made to fly. Our two champions of this friendly bet were F/L. Fowler, R.A.A.F., and F/O. Hugo, both fine pilots with a good insight into aeronautical engineering as well. A little group of volunteers including myself, then an A.C.1 flight rigger, started to work on the aircraft with these two officers in our after-duty hours. The French supplied a good deal of the material necessary.

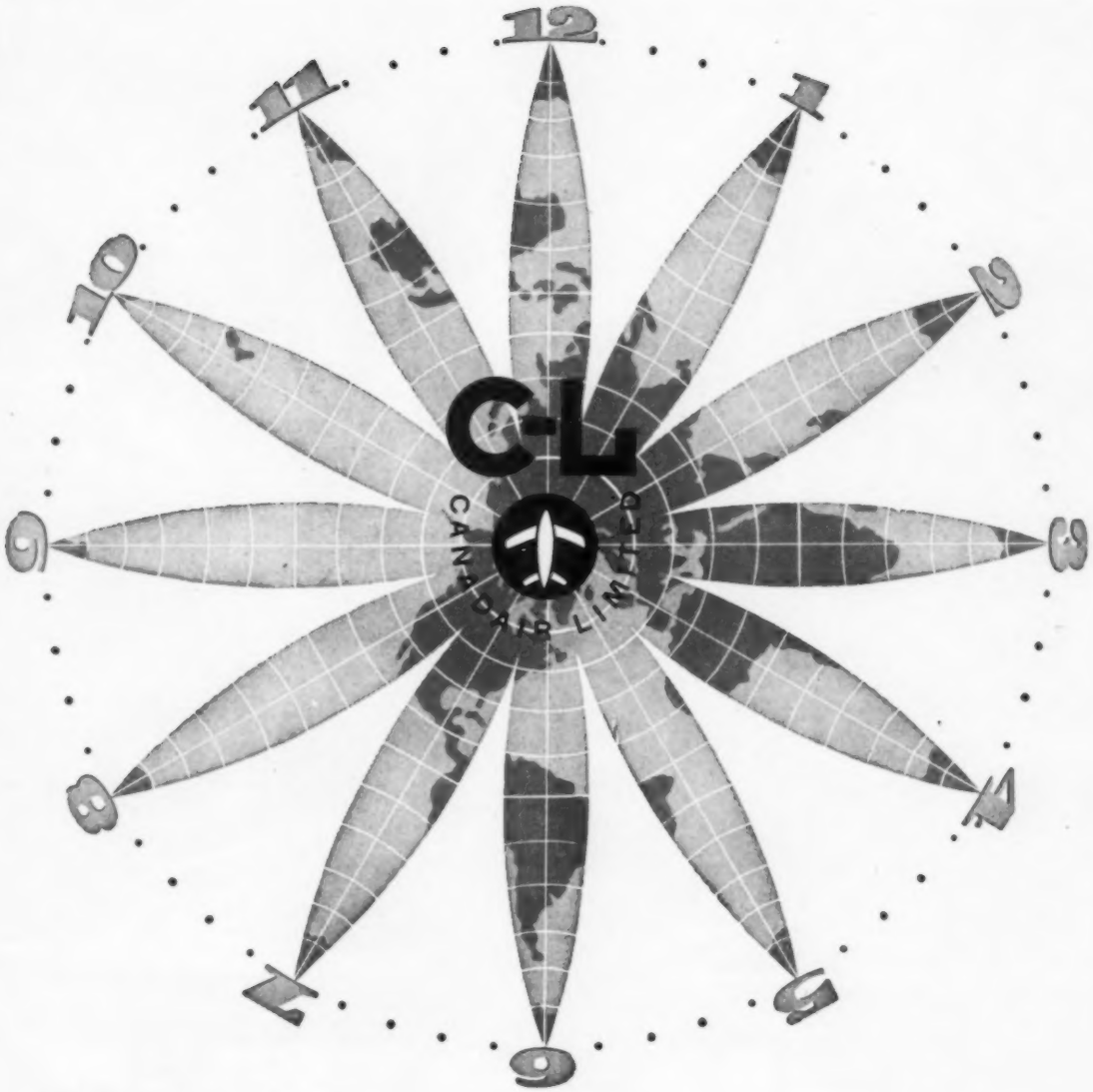
The basic airframe structure was found to be sound despite its 21 years, the biggest job being the covering of approximately one third of the main plane area. A large split in the airscrew blade was glued and bound with stringing cord."

F/O. Hugo, I think, was mainly responsible for servicing the Clerget rotary engine and I might add that our complete stock of castor oil, normally used for the B.T.H. compressors of our Gladiators, went into the oil tank.

The fuselage, minus mainplanes, was eventually pushed out for its initial engine run and I had the privilege of swinging the airscrew. Amid cheers from the onlookers the Clerget was soon chirruping round with an accompanying smell of burnt castor oil that would have brought back nostalgic memories to many old R.F.C. men. After one or two small fires due to maladjustment of the mixture control the cockpit drill on this old engine was mastered, and final preparations were made on the rest of the aircraft.

Rigging of the mainplanes was a rather hit-or-miss affair. The incidence was left to my somewhat youthful judgment, so, bringing to the fore my few pre-war years of model aircraft designing, I suggested two degrees. Two degrees we made it, and no dihedral angle. It looked all right to me and the two intrepid airmen made no adverse comment, so I mentally crossed my fingers and helped with setting up the flying controls.

The day of the first flight was a memorable one. It was windy, and four of us directed the Morane to the downwind



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Personally speaking

—a series of contributions on questions of the hour by leading aviation personalities.

GERHARD HÖLTJE

Technical Director of Deutsche Lufthansa and one of the men most concerned in the reconstruction of German Civil Aviation, makes this contribution on the . . .

Problems of building up an airline

We are only in the early stages of development. The unwelcome effects of the 10-years' break make themselves felt everywhere, particularly where air crews are concerned. In spite of their own personnel difficulties, BEA and TWA have lent us several of their best pilots until our own air crews are properly trained and have enough experience to master unassisted the duties imposed by modern air traffic. The new German Civil Pilots School will be responsible for training the necessary reserve of pilots.

The limited size of our fleet has hindered us in developing our routes, which will be extended to about 26,500 km. by the end of 1956. We have now ordered 7 Vickers Viscounts and, like other airlines, we expect to put our first jet aircraft into international service in about 1960.

I have had the greatest pleasure and satisfaction from the fact that when Lufthansa reappeared in international aviation we were welcomed as an equal by the other airlines, who offered us their support without prejudice or selfishness. This showed a corporate spirit which alone can overcome the international problems of Civil Aviation.

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CORRESPONDENCE . . .

side of the field. I forget who actually did the initial take-off, but the machine was airborne in a very short time and climbing steadily. After a few minutes of steady flying we were treated to some quite hectic low beat-ups and tight turns; I still remember the sight of Hugo's flying-boots as the Morane swept round in a vertical bank at nought feet!

Several flights were made, notably one which ended on the beach at Wissant, much to the surprise of the local gendarme. The engine was reluctant to start and the tide was rapidly reducing the width of the "runway"; nevertheless, with the port wheel throwing up clouds of spray in the surf the old kite made it back to St. Inglevert safe and sound.

The days of the "phoney war" were by this time almost at an end and our flight was recalled to Vitry-en-Artois. I believe an attempt was made to fly the Morane there, and it force-landed in a field on the way.

Our squadron, re-equipped with Hurricanes, was soon taking part in the grim fighting over France and Belgium. F/L. Fowler, I believe, was taken prisoner after being shot down, but F/O. Hugo survived the war on the right side.

Thorpe Bay, Essex. KEITH A. BELCHER.

Small Autopilots

MAY we reply to the letter from Mr. Paul Harvey of Federal Telephone and Radio Co., in your issue of September 28? F.T.R. claim that their automatic pilot is the "only tubeless pilot" at the "lowest price" and "first in its field" for aircraft under 7,500 lb gross take-off weight, and then apparently make their own rules about what is tubeless. In the English language "tubeless" means "without tubes," as Mr. Harvey points out; but in aeronautical language, when applied to an automatic pilot, surely it means an equipment which uses electrical signalling between the gyro and the servo without resource to vacuum tubes. The type of gyro or servo is irrelevant since these, in themselves, do not normally use tubes, and the purpose of claiming this feature is presumably because some users feel that the elimination of vacuum tubes cuts out one source of unreliability. Therefore the Sperry AL1A is a true "tubeless" automatic pilot, and on present quoted prices (F.T.R. quoted at £712, Sperry AL1A quoted at £557) it is certainly cheaper than the F.T.R. equipment; it also preceded it by some years (F.T.R. 1956, Sperry 1952).

The Sperry AL3 is tubeless in that no vacuum tubes are used in the automatic pilot system, although it is true that it gets its heading reference from the gyro unit of a Gyrosyn compass and such a compass employs vacuum tubes in the amplifier. However, a vacuum-tube failure, or for that matter complete failure of the compass amplifier, would not affect the use of the AL3 automatic pilot, which will function quite satisfactorily even if the compass amplifier is switched off. Therefore we do not consider the compass amplifier in the automatic pilot signalling circuit, which can, therefore, be claimed as "tubeless."

We are, of course, interested to note that F.T.R. vertical gyros are of Sperry design, and this only emphasizes our point that proven gyro references are an essential!

As regards Mr. Harvey's statement that "knowing how vigorously public relations people bring new . . . philosophies and equipment to the attention of the public" he can only assume that we have not made similar claims for the AL1A because they are not valid, we can only comment that he doesn't know British public relations people very well. We do not make these claims because (a) without detail they mean little, and (b) they are easy to make if you qualify them sufficiently, but they are difficult to prove, and we endeavour to keep our claims down to facts that we can establish.

We had thought that F.T.R.'s claims were made in ignorance of our products, but it would seem that Mr. Harvey has some information; we shall be pleased to supply him full details so that without further resource to *Flight* correspondence columns [Yes, please—Ed.] he can check our claims. Perhaps he would like to reciprocate.

Brentford, Middx. K. I. T. RICHARDSON,
Superintendent, Publicity Services, Sperry Gyroscope Co., Ltd.

The Sopwith 1½-Strutter

WITH reference to Mr. Bruce's remarks on the observer's gun mountings, in his recent article on the 1½-Strutter, I have a photograph of "B" Flight, No. 70 Sqn., R.F.C., from which it is possible to confirm that this Flight did carry Nieuport ring mountings.

Wallington, Surrey. PETER G. COOKSLEY.

I WAS very interested to notice in the excellent article by Mr. Bruce on the 1½-Strutter, mention of the Lewis gun mounted on the top wing of the single-seater machines of No. 5 Wing, R.N.A.S.

The photograph [reproduced here.—Ed.] shows aircraft of the

1½-Strutters of No. 5 Wing, R.N.A.S. (letter from Mr. G. Stuart Leslie).

Wing in the snow at Coudekerque, and it will be seen that single-seaters A.2, A.3 and A.8 have the wing-mounted Lewis, whereas A.5 has the more usual armament of the single Vickers.

May I make a plea for more articles and photographs of the 1914-18 era in view of the resurgence of interest in the subject which I feel has been greatly helped by your enlightened attitude in recent years?

Scarborough. G. STUART LESLIE.

The Vulcan's Last Journey

THURSDAY, the thirteenth of September, was a great day for all "planespotters" in Sydney; the Vulcan was coming to celebrate Air Force Week in Australia. After a record-breaking flight to Australia, the delta-wing bomber was flying from Melbourne to Sydney. A few minutes before 11 a.m. many eager eyes peered towards the south. I, with half the class, absented myself from a maths. period to see the "flying triangle" make two very low-level runs over the city, then position itself for its landing run. The headlines next morning were full of the Vulcan.

Next Saturday I rode 20 miles with a friend to Kingsford Smith Airport to inspect the bomber, two photographs of which are enclosed; a Royal Australian Air Force Canberra bomber is seen in the background of one. [Our young correspondent's pictures, while effective in composition, are not of a quality suitable for reproduction.—Ed.] The same day, the Bristol Britannia arrived on its proving flight after flying non-stop from Darwin. These two wonderful aircraft formed the most impressive duo ever seen in Australia. An estimated five thousand people saw the pair on Sunday.

Late on the Sunday afternoon, the Vulcan took off and passed low over Mascot in a final salute before flying to Adelaide.

This morning, October 2, I was extremely shocked to read of the Vulcan's tragic accident at London Airport. Everyone I have spoken to was deeply shocked and sympathized with the relatives of the crew.

My photographs of the Vulcan (serial number XA897) must be among the last taken of it.

Eastwood, N.S.W. JOHN HODDINOTT.

FORTHCOMING EVENTS

Oct. 23. R.Ae.S.: Section Discussion: "Functional Efficiency of Aircraft," introduced by C. Abell, O.B.E., F.R.Ae.S., and A. V-M. A. F. Hutton, C.B., C.B.E., D.F.C.
Oct. 24. Kronfeld Club: Talk on Popular Flying.
Oct. 25-26. Aircraft Electrical Society: Annual Display, Los Angeles.
Oct. 26. Aerauto Association: Dinner and Dance.
Oct. 26. Kronfeld Club: Annual General Meeting.
Oct. 26. College of Aeronautics: Tenth Anniversary Dinner, London.
Oct. 30. R.Ae.S.: Graduates and Students Section: "Nuclear Power for Aircraft," by E. P. Hawthorne.
Oct. 31. British Institution of Radio Engineers: Annual General Meeting and Presidential Address.
Oct. 31. Institute of Welding: Annual Dinner.
Nov. 1-2. Institute of Welding: Joint Meeting with the Netherlands Welding Society.
Nov. 2. Helicopter Association: "Development of the Skeeter Helicopter," by T. D. Nisbet, A.R.Ae.S.
Nov. 6. R.Ae.S.: Main Lecture: "London Airport," by Air Marshal Sir John D'Albiac, K.B.E., C.B., D.S.O.
Nov. 9-10. Agricultural Aviation Show, Palmerston North, New Zealand.
Nov. 13. R.Ae.S.: Section Lecture: "Air Conditioning of Aircraft," by Dr. E. W. Still, F.R.Ae.S.
Nov. 16. Institute of Navigation: "Navigational Aspects of Turbo-prop Operations over the North Atlantic," by J. E. D. Williams.

R.Ae.S. Branch Fixtures (to November 7).

Oct. 22, *Glasgow*, "Development of the Jet Propulsion Gas Turbine," by G. C. R. Mathieson. Oct. 24, *Luton*, Junior Night; *Bristol*, Brains Trust. Oct. 30, *London Airport*, "Design Problems of the Large Helicopter," by Dr. G. S. Hislop. Oct. 31, *Weybridge*, R. K. Pierson Memorial Lecture. Nov. 6, *Boscombe Down*, "High Speed Flight Problems," by R. F. Creasey. Nov. 7, *Luton*, "The Prestwick Pioneer," by N. J. Capper; *Bristol*, "The Dawn of Aerodynamics," by J. L. Pritchard.

THE INDUSTRY

Westland Share Issue

AN offer of 2.4 million ordinary shares of a nominal value of 5s each to shareholders registered on October 15, on a one-for-two basis, has been announced by Westland Aircraft, Ltd. John Brown and Co., Ltd., the largest shareholders, propose to continue their active assistance in the management and to take up two-thirds of their entitlement of new shares.

It is also proposed, after the cash issue has been completed, to capitalize £450,000 from the share premium account as increased by the cash issue, to pay up and issue free 1.8 million further Ordinary shares in the proportion of one new for every four held.

These offers follow an increase of trading profits as shown by preliminary figures for the year ended June 30 last. A dividend of 6¼ per cent, tax free, is proposed for 1955-56.

Other points from the chairman's review of the year are noted on an earlier page of this issue.

Frederick Bassett

IN the tragic Vulcan crash at London Airport on October 1, A. V. Roe and Co., Ltd., the makers of the aircraft, lost one of their leading technicians, Mr. Frederick Bassett.

Mr. Bassett, who was 38, joined the R.A.F. from school and left it as a corporal fitter in 1945, when he went to Avro as a fitter in the experimental department. He was later promoted to inspector and in 1950 became a member of the technical service department.

It was as Avro's chief Delta aircraft technical service representative and an expert on the Vulcan that Mr. Bassett made the trip to Australia and New Zealand.

Lightweight Instrumentation

A SAVING of 20 per cent in the usual weight of fuel measuring equipment has been made by Waymouth Gauges and Instruments, Ltd., in the installation they have developed for the Folland Gnat, and it is estimated that a saving of up to 40 per cent will be achieved by the time research work is completed.

Reduction of weight in the instruments has been achieved mainly in two ways, by the use of materials never employed before, and by a study of their structures to ensure they were being used to their fullest advantage. One of these materials is "Hostflon," a new lightweight plastic which has been used to separate and insulate the live and earth plates.

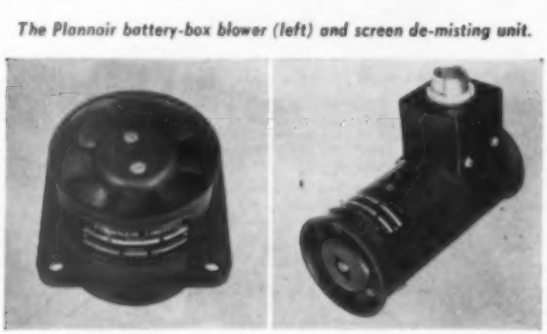
In addition to this fuel measuring equipment the Smiths group of companies (of which Waymouth Gauges and Instruments, Ltd., is a member) will be supplying most of the cockpit instruments for the Gnat. These include the 3½ oz E2A compass built by Kelvin and Hughes, Ltd., and the new Smiths' long-scale jet-temperature indicator in a 2in case.

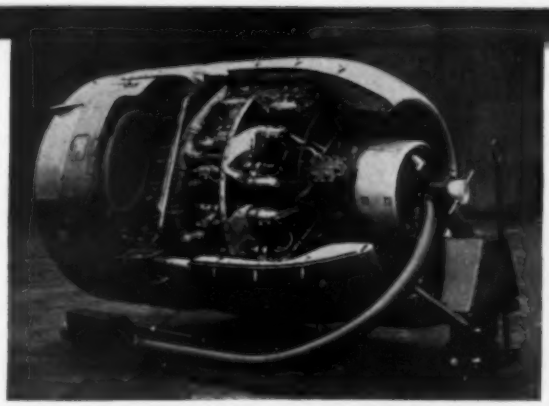
Britannia Ventilation

THREE types of axial-flow blowers, manufactured by Plannair, Ltd., of Leatherhead, Surrey, are being installed in the Bristol Britannia 310 for specialized duties.

Heat generated by the radar search unit in the nose is prevented from entering the flight deck by a 2PL 81-135 blower unit, which discharges it externally; a 2PL 81-115 type blower is used for battery box ventilation when the Britannia is on the ground; and as a result of recent experiments it is proposed that two 2PL 81-108H blower/heater units should be employed for de-misting the compound-curvature, sandwich-type flight-deck windows. Each of the two units, incorporating a Plannair motor-driven axial-flow blower with a 1 kW heater element, weighs under 3 lb and is only 5½in long by 2½in diameter.

The Plannair battery-box blower (left) and screen de-misting unit.





The Scoba Engine Porter, referred to below.

Assisting Engine Maintenance

THE Scoba Engine Porter, which is manufactured in this country by Aerocontacts, Ltd., of Gatwick Airport, Surrey (and which was described in *Flight* for November 26, 1954, p. 782), is now available in three sizes. These enable it to handle a complete range of radial engines and powerplants, from the P. and W. R.985 Wasp Junior up to the Wright R.3350 and Bristol Hercules and Centaurus. In each case the device supports the engine by the airscrew shaft, thus allowing the fullest possible accessibility.

The Scoba engine tilting sling has also been so developed that it can now handle all P. and W. engines from the R.985 to the R.2000; and a new model has been produced for handling the R.2800.

IN BRIEF

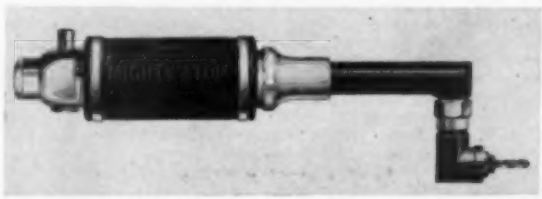
Mr. G. G. Roberts has been elected a divisional director of the aircraft division of the S. Smith and Sons group of companies.

* * *

The first of the post-graduate scholarships in electronics inaugurated by Blackburn and General Aircraft, Ltd., in collaboration with the University of Southampton, has been awarded to Mr. Kenneth Brewster, B.Sc., a graduate of Sheffield University.

* * *

The Stewart Aeronautical Supply Co., Ltd., Adastral House, Lowfield Heath, Crawley, Sussex, has produced a quick reference stock-list, detailing units and accessories available (as at September 1) under A.M. reference numbers and makers' part numbers.



Designed primarily for the aircraft industry, this new Desoutter pneumatic drill has an offset head which can be rotated through 360 deg and locked in the required position. Capacity is ¼in. (Desoutter Bros., Ltd., The Hyde, London, N.W.9.)

P. Frankenstein and Sons, Ltd., Victoria Rubber Works, Newton Heath, Manchester, 10, have issued an attractively produced catalogue describing and illustrating many of the items of high-altitude, life-saving and survival equipment which they manufacture.

* * *

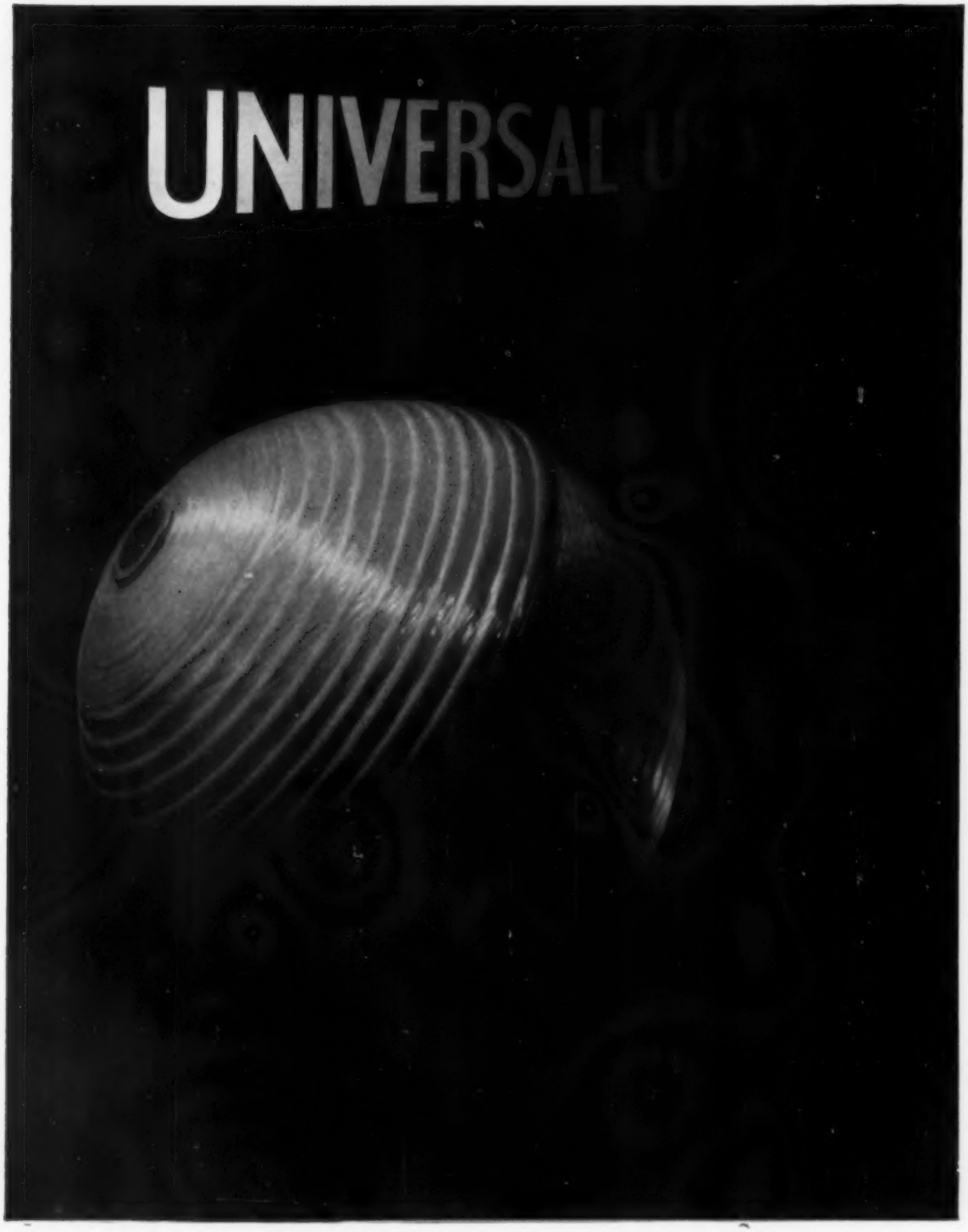
Lansing Bagnall, Ltd., Basingstoke, Hants, have formed a Canadian subsidiary. Known as Lansing Bagnall of Canada, Ltd., the new company is to have premises in Toronto, Ontario, and it will be managed by Mr. P. A. Berry, formerly export sales manager in England.

* * *

Mr. Paul K. Brewin has been appointed group personnel officer for the British Tyre and Rubber Co., Ltd. He was previously personnel manager of the Southern United Telephone Co., Ltd. (Dagenham Cables) and before that held a similar position with Vickers-Armstrongs, Ltd., at Weybridge.

* * *

The 240-page *Year Book, 1956*, issued by Teddington Aircraft Controls, Ltd., Merthyr Tydfil, S. Wales, is, in its clarity and comprehensiveness, a model for such publications. Besides describing (with full technical data) and illustrating each of the company's products, it has a section index usefully tabulated in different colours for quick reference.



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ROTAX have available lightweight, high-pressure (3,000 P.S.I.) fibre-glass spheres for non-corrosive liquids and gases. Further details will be given upon request.

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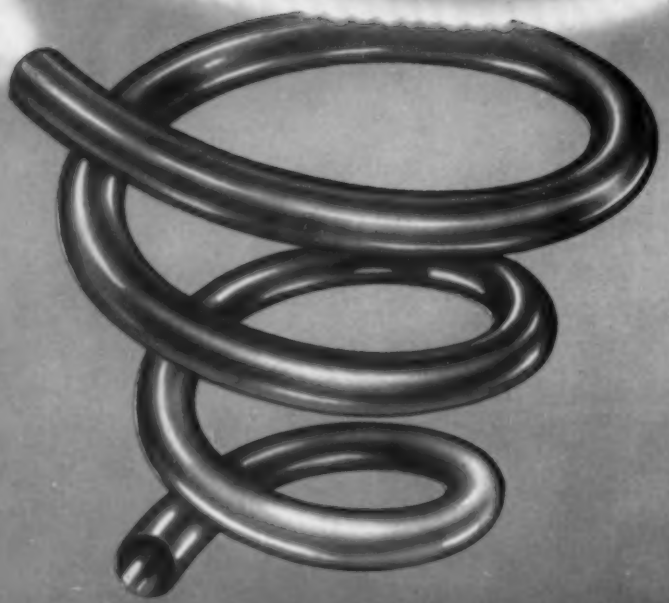

CERROBEND

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"Real smooth" was the test pilot's comment on the maiden flight of the first Lockheed L.1649A Super Star Constellation at Burbank on October 11. The aircraft is seen here taking off on its 50-minute flight over Los Angeles.

CIVIL AVIATION

DANGEROUS SOUND

WRITING in the British Air Line Pilots' Association magazine *The Log*, Capt. L. Arthur, D.F.C., F.R.Met.S., A.R.Ae.S., studies the effect of acoustic energy upon an aircraft structure and makes several recommendations for the safe design of transport aircraft. Some doubt still exists as to the true relationship between the "loudness" of a sound and the acoustic energy it produces; but the destructive effect of the equivalent pressure-rise is thought by Capt. Arthur to have been insufficiently considered—notwithstanding the immense amount of Comet 1 research in this field. One example he quotes is that the noise pressure from an engine exhaust may affect the accuracy of a pressure altimeter.

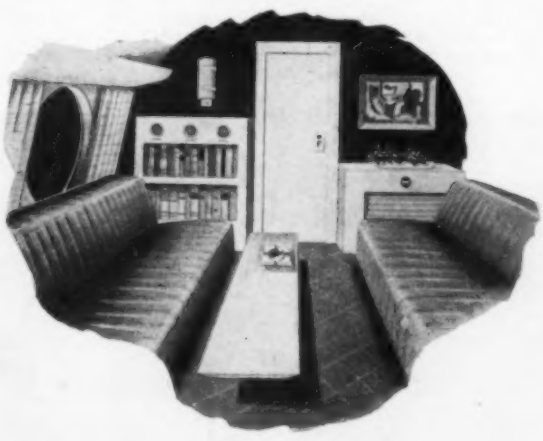
Capt. Arthur's argument is based upon the premise that any of the structure within an included cone angle of 60 deg from the jet efflux is in danger from "ultra-audible" noise and pressure pulses (which may reach 30,000 c.p.s.); a danger which, he considers, will be greatly increased by the shear velocity of efflux. In support of these contentions, the author quotes the results of fatigue tests made this year by the N.A.C.A. laboratories on panels subjected to loud noise. These tests showed that a small panel 0.03in thick would fail in twenty seconds when subjected to 167 db, or in 1,000 min when subjected to 140 db; the proximity of the sound source is not stated.

The author also concludes that damage from this cause is most likely to occur on the ground when the relative velocity of jet efflux and airflow is a maximum; these dangers should, he feels, be brought to the attention of the ground engineers, the jet pipes should be positioned to keep the critical cone angle clear of the structure, and rigid panels should be provided in the rear fuselage.

Even these precautions may not be sufficient to exclude all likelihood of failure since vibration can be transmitted and re-created far from the original source of energy. Consideration should be given, Capt. Arthur suggests, to elastic discontinuities in the path of the vibration and special high and low frequency damping mountings should be devised for the power units.

Better still, since the loudness of a sound varies inversely as the distance squared, the engines should be mounted as far away from the fuselage as possible. The efflux cone will then be clear of the structure, localized noise source and high frequency vibration near the fuselage (as with a buried engine installation) will be reduced, and at high altitudes the reduced air density will limit the noise-level in the pressurized zone.

These criteria point towards the podded installation, the author concludes, and where this is combined with swept-back wings the noise level is reduced and the need for sound-proofing decreased, as the exhaust will be effectively aft of the passenger cabin. Capt. Arthur suggests that his preliminary noise study has opened up a field for fruitful research.



The appeal of the Viscount as an executive transport—eleven have so far been sold for this rôle—is certain to be widened by the new Viscount Executive (see news item above). Here is an impression of the conference lounge—one of three proposed arrangements.

BUSINESSMAN'S VISCOUNT

WITH the Viscount selling steadily as an executive transport (four delivered, seven on order) Vickers have been encouraged to offer the aircraft specially tailored for the executive rôle. Backed by illustrations and documentation altogether worthy of its rich potential market, the Viscount Executive appears to offer the ultimate in "custom-styled" interior design. Obviously there can be no such thing as a "standard executive version" of a transport aeroplane, since personal tastes and bank accounts differ widely. But a basis of discussion is essential, and drawing office man-hours spent on illustrating in detail the scope for custom-styling are more than likely to pay off.

Several schemes are proposed for the Viscount, each having in common a main compartment with eight spaciously arranged armchairs and tables, all positioned to take full advantage of the Viscount's large windows. A typical layout of this compartment provides for three pairs of chairs facing across folding three-leaf tables, plus two other individual chairs (one of them, suitable for secretarial use, facing a desk).

It is in the lounges, however, that the most appealing possibilities are apparent. One, a conference lounge (situated forward) is illustrated below. Another, also forward, is similar in layout but styled more as a private room. The third, a continuation aft of the main cabin and contrasting pleasantly with the latter's businesslike appearance, is a cocktail lounge with curving sofa and low tables.

From the performance point of view the Viscount Executive will conform exactly with the North American version of the 700D (Rolls-Royce Dart 510 engines).

AID FOR THE AFGHANS

ACCORDING to *Time* magazine, the United States is to lend $14m to Afghanistan for the modernization of the Afghan Aryana airline—an operation that will include the buying of new equipment and the building of a first-class airfield with a 12,000ft runway at Kandahar near the Pakistan border. The agreement has been concluded between the U.S. Government, Afghanistan and Pan American World Airways, who will be granted an option to obtain a holding of up to 49 per cent in the Afghan airline's stock. In return, P.A.A. will assist Afghan Aryana by advising upon and supervising the development and modernization of its operations and its equipment, as a step towards developing Afghanistan as an international air link between East and West.

CIVIL AVIATION . . .

AIRPORTS IN THE NEW ERA

THE acting administrator of the Civil Aeronautics Administration, Mr. James Pyle (a photograph of whom appears at the foot of col. 2), recently gave his views on airport development in an address which was read to the Spokane Wing of the Air Force Association at a Jet Age Conference in Washington. Tracing the development of other forms of transport, Mr. Pyle reminded the conference that lighthouses for ocean-borne transport, loans and land-grants for railways and the conversion of rutted dirt roads into motor highways had been a state and Federal Government concern; but although municipal and private capital had been used to build airports for many years, it was not until after the second world war that the U.S. Federal Government took a major part in airport construction. The present building and modernization programme that is financed with government, state and municipal appropriations is scarcely able to keep pace with the mushrooming growth of civil aviation, Mr. Pyle warned, although by 1959 over a billion dollars will have been invested in post war airport development.

The C.A.A., the acting administrator continued, "views the jet age as an evolutionary, rather than a revolutionary, development." He did not think that the problems with which the administration would be faced were much different from those which have already been overcome on piston engined transports—in spite of the higher cruising speeds of the new jet aircraft, approach and landing speeds would not be very different and the bulk of jet flights will be made with only part-full tanks, so that the jet transport could, he predicted, "accommodate itself to the runways now existing at the larger municipal airports. . . . It may be necessary to add to the paving thickness at some airports, particularly if the jet transports are heavily loaded. However . . . the runway problem from a load-bearing standpoint does not appear to present us with any immediate crisis." Other particular problems which Mr. Pyle considered to be important were the size of terminal buildings when 150 people at a time essayed to pass through with their baggage (although this was a problem of aircraft size, not of type); the hazard of debris being sucked into the intake—periodic cleaning with a giant mobile vacuum cleaner would probably be necessary; and the difficulties of storing and delivering adequate fuel at airports to meet the increased needs of jet aircraft.

Perhaps the gravest concern facing military and civil aviation is the problem of noise. "It is partly a matter of human psychology," the lecturer continued, "and whenever human beings enter the picture it is difficult to forecast just what their reactions will be. Will [the noise of the jet] be more objectionable to people on the ground than the vibrating roar of the piston engine? Or will it, as we hope, prove more acceptable and tolerable to the average person than today's aircraft noises?" Whatever the answer, Mr. Pyle concluded, "none of the problems and difficulties that I have mentioned is going to stop aviation dead in its tracks."

TOWARDS THE PERFECT AIRPORT?

IN its one hundred and twenty pages, I.A.T.A.'s new document *Planning of Airport Buildings and Aprons* contains an immense number of carefully considered recommendations. A good deal of space is devoted to a close consideration of the various merits and disadvantages of stand, "finger" or open-apron parking systems, the choice of which is fundamental to optimum finesse in the easy and convenient transit of large numbers of passengers simultaneously into the processing areas.

Sensible layout has such a great influence upon efficient (synonymous for speedy) ground operations that the document repeatedly urges that the airlines should be consulted while plans are in the embryo stage, and suggests that an airlines committee forming a cross-section of the airport users should advise upon their likely operational requirements. Dispersal of personnel and equipment, complex internal layout, aprons of inadequate size and shape—all are particular pitfalls that the airport planner must avoid. Baggage handling is one example of the problems to be resolved. Labour is an expensive and generally inefficient handling medium, yet the ideal conveyor system—a belt—is very inflexible. As a result a choice depending upon the circumstances must be made. This is the lesson the report seeks to drive home: expansion and alterations are very costly, and careful aforethought must lead to the right decisions now.

MOCK-UPS AND MONEY

GONE are the days when the design office was grudgingly granted a few square feet of experimental department floorspace in which to build a new mock-up. It seems, too, that the accounts department is now convinced of the need for a costly design and construction effort. We noted the elaboration of Boeing's dummy 707 interior (*Flight*, June 1), which cost as much as a Friendship; we reproduced in last week's issue a picture of Douglas' elaborate DC-8 mock-up; and now we hear that Convair have just started work on a completely new *building*, costing nearly £100,000, in which to house two full-scale mock-ups of the Convair 880 jet airliner. There will be one full-size fuselage, including port wing (with engines) and tail assembly, together with another complete fuselage in which, no doubt, the furnishings department will be able to play to their heart's content. The steel and concrete building, scheduled for completion on February 1 next, measures 200ft long by 100ft wide, and will have its own offices and workshops.

B.E.A.'S SLOWER EXPANSION RATE

WHEN B.E.A.'s financial results for 1955-56 were published (*Flight*, August 24 and 31) it was stated that the increase in revenue since April had not been up to expectations, owing to the general economic situation. "We had," said Lord Douglas (chairman and chief executive) "budgeted for a profit of £750,000, but we are not quite making it."

A study of the Corporation's traffic figures for June, July and August confirms this expectation. Although traffic in those months increased by 13.7 per cent compared with last year, the increase was nevertheless not as great as the 18 per cent expected.

However, despite the "credit squeeze" and unsettled political

Marking the first occasion on which the Viscount had been used for scheduled all-freighting, one of B.E.A.'s fleet left London on October 10 for Milan with four tons of cargo on board. The new twice-weekly night service is part of B.E.A.'s drive for more cargo and for higher round-the-clock Viscount utilization.

James T. Pyle (left) C.A.A. acting administrator (see col. 1) seen accepting from Col. Stephen Mack, commandant of Shaw Air Force Base, a model of the B-57 (Martin-built Canberra). The C.A.A. has just accepted the first of a number of B-57s to carry out its "jet age" civil aviation research programme.

The Dove, now in its twelfth year of production, continues to sell steadily. Here is the 476th specimen, an executive version built for C. A. Parsons and Co., Ltd., of Newcastle. It was delivered by Capt. B. Allum, the company's pilot.

AUSTRIA IN THE AIRLINE MARKET

NOTHING was heard until recently of the two commercial airlines formed earlier this year in Austria. One, Austrian Airways, was backed by S.A.S. (*Flight*, April 6), and the other, Air Austria, by K.L.M. (*Flight*, January 20). In addition to foreign airline interest, however, there was a good deal of domestic political wrangling—the former airline being backed by the Socialists and the latter by the Conservatives. Now it appears that all the opposing interests—political and commercial—have been reconciled, and a single Austrian company, due to start operations in the spring of 1957, has emerged. An Austrian Government announcement said that the extent of S.A.S. and K.L.M. participation had "still to be settled."

QANTAS ANNUAL REPORT

THE lowest Sydney to London air fare has fallen 8 per cent. in eight years, despite a rise in the cost of living in Australia of 85 per cent. in the same period, stated Qantas Empire Airways in their recently issued annual report. During the same period, said the company, tourist-class sea fares to London had risen by 53 per cent.

Lower tourist-class fares on Qantas international routes had, the report said, contributed largely to the record numbers carried in 1955. A feature of the year's operations was that 48 per cent. of the passengers on the Qantas service to London and 40 per cent. of passengers on the North American service travelled tourist class.

The statement said that Qantas had a record business year in 1955, when it carried 134,904 passengers and made an operating profit of £320,000. This was achieved after providing £200,000 for taxation and represented a return of 6.9 per cent. on capital. The company declared a dividend of 5½ per cent.

conditions in the Mediterranean and Middle East, B.E.A. carried more traffic in the month of July than in any month in its history: for the first time the Corporation flew 100m passenger-miles. In August traffic came within four per cent of expectations, producing the high load factor of 77 per cent.

Commenting on these results Lord Douglas warned that rising costs demanded further improvements in productivity, cost-cutting and sales effort, which during the coming winter would be "all-out." He looked forward to introducing the first Viscount 800s during the winter, first on the London-Paris route and subsequently on "other short-haul routes for which it has been specifically designed."

AIR CEYLON BRANCHING OUT

A DIRECT air service from Colombo to Peking and Shanghai has been proposed by Air Ceylon, who intend also to seek traffic rights for a service to Tokyo (Air Ceylon is already the agent for Japan Airlines). "It is going to be a period of expansion," said Mr. J. L. M. Fernando, general manager of the airline. "Air Ceylon is definitely out of the woods, and our balance sheet shows that we have doubled the net profits."

WORLD'S SECOND JET SERVICE

IT is proving very difficult to keep track of the many reports we receive about the services now being operated by the Tu-104. Despite the obvious desire of the Russians to impress the West with the Silver Arrow (as it is reported to have been named), no official record of its progress is forthcoming.

It does seem, however, that Aeroflot now have the aircraft in regular scheduled service between Moscow and Yakutsk in Eastern Siberia, and (to the south) to Tbilisi, capital of Georgia. The date on which the first scheduled service—the world's second—actually took place remains elusive.

Last Friday, however, was the day on which the Tu-104 made its first link-up with a Western airliner, when regular operations began between Moscow and Prague, connecting there with the Air France service from Paris. There is now a connection between Paris and Peking.

On October 17, according to a Reuter report from Moscow, the Tu-104 was due to open a service between Moscow and Tashkent in the south, and to Khabarovsk on the Manchurian border.

Structural details of the Electra are evident in these new photographs from Lockheed. Above, frames and stringers of a full-sized "tool-proving" mock-up of the fuselage. Below, Lockheed project engineers with their "function-proving" model of the Electra's undercarriage.

The Herald demonstrating its take-off capabilities at Alderney. It was airborne in considerably less than half of the 950 yd of grass runway available.

Herald in the Islands

THE Handley Page Herald's tour of the Channel Islands last Friday was beyond doubt a successful occasion. Comments of airline officials and casual passengers alike were favourable and anticipatory: "There is no doubt that the Herald can be operated safely in the Channel Islands. The point is proved," declared Mr. M. L. Thomas, the managing director of Jersey Airlines, and: "Shall we soon be seeing that attractive aeroplane here regularly?", inquired two lady passengers awaiting a scheduled flight in the lounge of Guernsey airport.

The take-off for the islands, which was delayed by fog, was made from the Handley Page factory at Woodley and the first half-hour in the air provided us with an opportunity to assess some of the passenger appeal of the new branchliner, which was fully equipped as a 36-seater. The noise level, which was unexpectedly low on the climb, was very subdued indeed at a steady cruise condition—and a good deal quieter than was implied by the high-wing position in which the four Alvis Leonides Major engines are mounted. Certainly it was acceptably better than most passengers in aircraft designed for the Herald's operating rôle would be prepared to tolerate. Except in the sparsely soundproofed toilet right aft, the noise level decreased slightly towards the rear of the cabin. The plane of the airscrew discs is exactly in line with the forward bulkhead in the cabin, but even here the decibel-level was by no means excessive. As with all piston-engined aircraft there was some slight vibration, which was transmitted into the fuselage as a barely perceptible low-frequency lateral shake of low amplitude.

The cabin colour scheme is an attractive mushroom-grey with contrasting red. The Vynide-covered walls are in the restful pinky-grey colour and the roof and hand-luggage racks are cream. The paired non-adjustable seats are upholstered in cloth, with bright red leather under-knee and head sills. A combined steward-call button, punkah louvre and swivel reading light are provided for each passenger in a single paired panel (for each double chair) under the overhead racks. Normally, the Heralds in service would be pressurized to a maximum of 3.35 lb/sq in; G-AODF, the second prototype, was incomplete in this respect; but at our height of 7,000ft it passed unnoticed.

One feature of the Herald's cabin that attracted particular attention was the headroom, which even under the spar would enable a man six feet tall to walk upright beneath the wing centre-section. An unrestricted downward view is provided by the quite generous double-panel windows; the raised seat backs do, however, make it difficult to see very far forward or aft. The inboard nacelles and undercarriage legs, which to occupants of the central-cabin seats appear formidable obstructions on the ground, pass unnoticed in the air when the wheel-well doors are closed. Retraction of the flaps and undercarriage can be observed from these seats but was not accompanied by any disturbing hydraulic gurgles.

One of the declared objects of the day's Alderney exercise was to demonstrate the aircraft's short-field capabilities on the island's 950 yd grass runway—an attempt which was delayed for some minutes while stray cows were rounded up and tethered. S/L. H. G. Hazelden's landing was both uneventful and unspectacular. The touch-down was made comfortably within the airport boundary and the landing run was completed within about 650 yd, allowing a good margin of additional run should it have proved necessary. The advantages of the Goodyear anti-skid units on the wet grass were most apparent—a steady and appreciable braking retardation was obtained throughout the run.

Outside the tiny airport building, the Herald was welcomed by the islanders and by officials of Jersey Airlines, among them the managing director, Mr. M. L. Thomas, who had flown over in a D.H. Rapide to see for himself the largest aircraft (the landing weight was about 32,000 lb) ever to land on Alderney.

The east-west runway at Alderney used by the Herald on its first landing is likely to be the one that would be regularly used in service; the other two grass strips which are available are appreciably shorter, with rather awesome approaches over the sea and cliffs. The demonstrated performance of the Herald at Alderney—on a day when the surface wind was unlikely to have exceeded five knots—leaves no room for doubt that day-by-day operations by airline pilots would be entirely practicable.

From Alderney passengers in the Herald and the Rapide exchanged places in order that the Jersey Airlines people could "see for themselves"; and we, for our part, were able to watch and photograph the Herald's take-off from the island. The aircraft looked huge at the end of the runway and ridiculously close to our vantage point opposite the control tower. A few hundred yards behind it was the sea; 950 yd ahead were rough pasture and rocks; and then the sea again. Yet the take-off was all so simple—Hazelden lifted the wheels off in less than 450 yd and swung away into the mist in the direction of Guernsey—the take-off, like the landing, had been demonstrated as being as unspectacular as the Handley Page personnel had predicted.

During the Guernsey stop, two of the island's civil dignitaries, Air Marshal Sir Thomas Elmhirst, the Lieutenant-Governor of Guernsey, and Sir Ambrose Sherwill, the Bailiff of Guernsey, were given a flight around the island in the aircraft. Their favourable impression was a general reaction; Mr. Thomas of Jersey Airlines said after his flight from Alderney that his company could make use of the aircraft for the numbers of passengers that they were carrying. In his opinion, J.A.L., which at present operate seven Herons and three Rapides, could use three Heralds, although, he said, it would be quite practicable to begin services with one. The link-up with B.E.A., who hold 25 per cent of the shares in J.A.L., would mean, Mr. Thomas added, that considerable thought would have to be given to the financial implications of purchasing Heralds (which cost about £145,000 without radio and unfurnished).

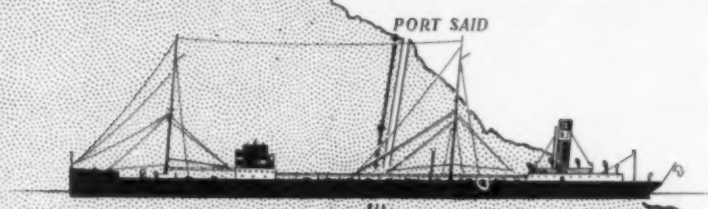
Another circuit by the aircraft for the benefit of the photographers rapidly began to use up the already depleted autumn day. To go on to Jersey was out of the question if Woodley was to be reached before dark, so we reluctantly turned towards home. The mist gathered beneath us as we enjoyed the last moments of sunshine and the clear blue sky above the inversion dust-bowl; but as we reached Woodley the sun disappeared, the lights were twinkling below and we landed in the gathering dusk.

Between 11.30 and 5.30 we had visited two Channel Islands, created a record for a landing and interested a lot of people in a very promising aeroplane. At the present time, 35 Heralds have been ordered and 100 are being laid down. If any directly attributable sales results of our trip are forthcoming, it must be because no other way of selling can be superior to demonstration over the customer's home ground, where the aircraft's comparison with existing equipment is anything but odious.

A. T. P.

Handley Page test pilot S/L. H. G. Hazelden discusses the Herald with Tommy Rose, well known racing and test-pilot of pre-war days.

'FIND THE LINK'



FROM

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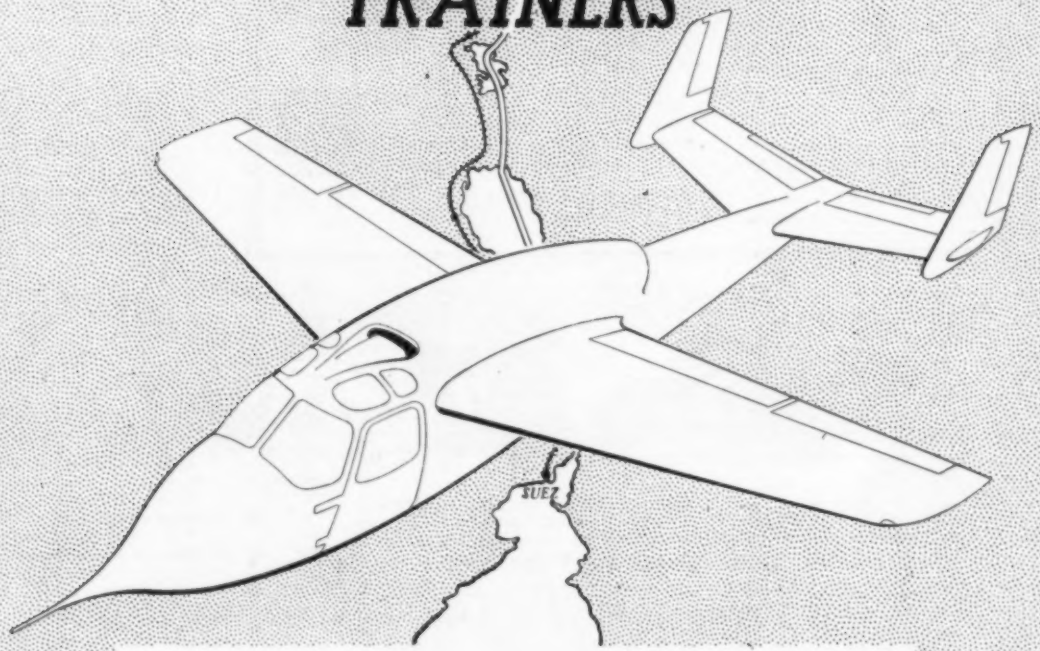
TRAINERS



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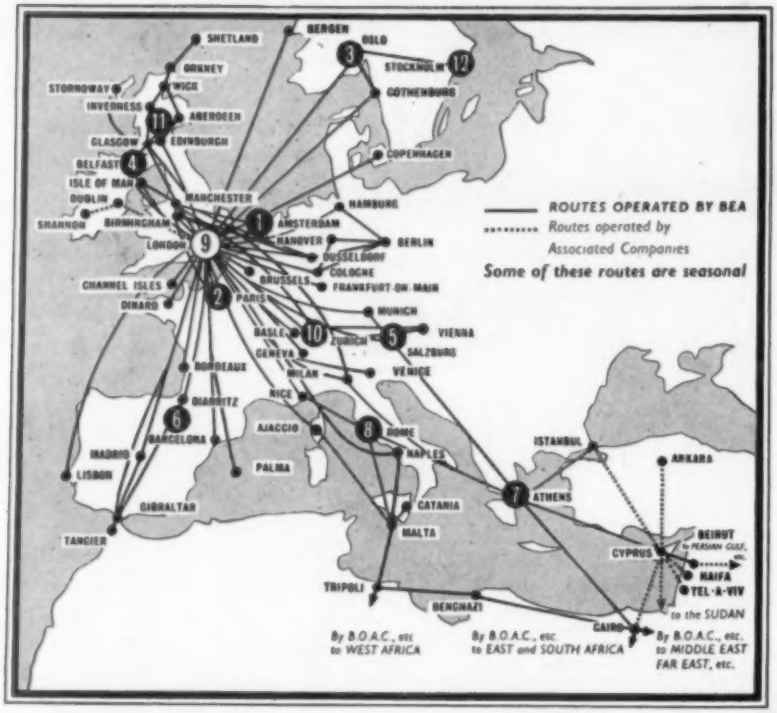

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BRITISH EUROPEAN AIRWAYS

Lt-Gen. Josef Kammhuber, head of the West German Air Force, inspects a guard of honour at Fighter Command Headquarters, Stanmore, on his arrival there to confer with the A.O.C. Fighter Command, Air Marshal Sir Thomas Pike (just visible in the rear).

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

W.R.A.F. A.D.C. to the Queen

IT is announced that Air Commandant M. H. Barnett, Director of the W.R.A.F., has been appointed honorary aide-de-camp to the Queen with effect from September 6. She succeeds Air Commandant Dame Nancy Salmon, who retired recently.

Air Commandant A. M. Williamson, Matron-in-Chief of Princess Mary's Royal Air Force Nursing Service, is appointed honorary nursing sister to the Queen with effect from September 1, in succession to Air Commandant Dame Roberta Whyte, who also retired recently.

Australia-Canada Exchange

AN agreement for an exchange of officers has been concluded between the R.A.A.F. and the R.C.A.F. The first officer so exchanged, F/L. V. J. Hill, left for the R.C.A.F. Central Experimental and Proving Establishment at Rockliffe this month. A Canadian officer, F/L. J. A. Moyles, will go to the R.A.A.F.'s Aircraft Research and Development Unit. The agreement allows for an exchange posting of one flight lieutenant of each Air Force.

No. 155 Squadron's Anniversary

IN Malaya, No. 155 Sqn. has celebrated its second anniversary of Whirlwind operation in the anti-terrorist campaign. Commanded by S/L. L. L. Harland, the unit's Whirlwinds have, during the two years, flown 25,802 troops, 1,694 passengers, 40 tracker dogs and one baby elephant.

Not counting the weight of arms, ammunition, rations and radio equipment carried by men of the security forces being airlifted, the Whirlwinds have transported nearly 400,000 lb of urgent freight. A total freight figure would be approximately 690,000 lb. S/L. Harland was last month awarded a Bar to his D.F.C.

No-Waste Cookery

SELECTED airmen cooks are being taught "Escoffier-style" cooking at a new cookery school set up at the M.E.A.F. (Rear) H.Q. at Episkopi, Cyprus. The school is being run on a grant of 1s 7d per pupil per day and no waste is involved. Dishes prepared are added to the menus of airmen's and officers' messes at headquarters.

By completing the six weeks' course, airmen cooks qualify for increased pay and gain prospects of early promotion to corporal. They learn to cook both indoors and in the open. Works of reference studied in addition to the standard R.A.F. cookery books are Escoffier's *Guide to Modern Cookery* and Saulnier's *Répertoire de la Cuisine*.

R.A.A.F. Helps Out

AT the request of the Australian Department of Civil Aviation, an R.A.A.F. G.C.A. radar unit will move from East Sale Military airfield to Essendon, the airport for Melbourne, to help with peak traffic in I.F.R. conditions during the period of the Olympic Games. Essendon's facilities are adequate for its normal operations, but greatly increased traffic is foreseen. Essendon's present capacity is for 24 movements an hour in instrument weather. A civil I.L.S. installation will be completed in time for the Games, but the new civil radar installations will not be ready. The R.A.A.F.'s assistance will raise the traffic capacity to 30 movements per hour.

Keen Photographers

TWO members of the R.A.F. Police who had been detailed to watch aircraft movements near Worthing sea-front on June 22 took photographs of two Fireflies, from R.N.A.S. Ford, which flew at between 100ft and 200ft over the pier. At a court martial held last week, Lt. J. E. Sanderson, from Ford, pleaded guilty to two charges of low flying and was sentenced to be severely reprimanded.

Canberra Escape

A TRUE story in the October issue of *Blackwood's Magazine* called "The Rogue" gives an excellent account of a baling-out operation fraught with more than usual risks which was carried out by the crew of a Canberra during a training flight last year.

Captain of the aircraft and instructor pilot was S/L. S. G. Hewitt, and F/L. Taylor was instructor navigator. Pupil pilot and navigator were respectively F/O. Bates and F/O. Leigh. S/L. Hewitt was flying the Canberra and F/L. Taylor and F/O. Leigh occupied the two ejector seats in the back. F/O. Bates, wearing a normal seat-type parachute, sat on the rumble seat.

During the climb after take-off from Bassingbourn the elevator trim "ran away" at just over 20,000ft and the aircraft went to the top of a loop. S/L. Hewitt rolled into a steep turn and the two navigators ejected, one of them surviving. (The

A Whirlwind belonging to "H.M.S. Protector" lands on its parent vessel at Portsmouth with Admiral the Earl Mountbatten as passenger. The First Sea Lord addressed the ship's company shortly before they sailed for the Antarctic to assist the Governor of the Falkland Island Dependencies in security duties. Two of the Westland helicopters are carried.

The Station Chaplain, the Rev. R. L. W. Pratt, consecrates the standard presented to No. 9 Sqn. at Binbrook on October 9.

SERVICE AVIATION . . .

seats were at that period manually operated).

The pupil pilot on the rumble seat then tried to get out through the entrance door, but got stuck. While he tried to get back on board, S/L. Hewitt was pushing with his foot to help him out. Then it was noticed that F/O. Bates' parachute harness had caught round the handle of the emergency hydraulic hand-pump. This was cleared and Bates successfully baled out.

Hewitt then ejected with his knee pressed against the control column to hold it forward against the trim force till the last second. He cleared the aircraft easily, but through the stress of the preceding efforts to clear Bates, he made the mistake of pulling his parachute rip-cord before releasing his seat harness. The seat drogue-line at once became entangled in the parachute rigging lines. Hewitt drew his knife and cut the drogue line, but the main canopy had been torn and he then had to cut away a piece of parachute which was covering his face. Finally, very late in the descent, he was clear and falling fast under the torn parachute. He landed heavily in a ploughed field but sustained no serious injury.

Meanwhile, Taylor's descent had not been entirely trouble-free; after releasing his seat harness, he found the seat falling close alongside him. By kicking hard he managed to move it away enough to allow safe opening of his parachute.

Bates' descent was normal. Leigh failed to release himself from the seat and lost his life.

S/L. Hewitt later received a Bar to his A.F.C., the citation commending his "leadership in this dire emergency, and his display of coolness and exceptional courage in the face of grave danger . . ."

Equerry to the Duke

APPOINTED as equerry to the Duke of Edinburgh during his visit to Australia for the Olympic Games is W/C. L. H. Williamson, D.F.C., R.A.A.F. He at present commands the Air Trials Unit at Woomera, and will return to this post after the Duke's departure.

Votes for Kangaroos

THE recent decision to adopt a kangaroo *motif* in the insignia of R.A.A.F. was the outcome of a poll taken throughout the Service. Voters were asked to say whether or not the standard R.A.F. insignia should be amended to include the Australian kangaroo emblem and, if so, what form it should take. No fewer than 81 per cent of all R.A.A.F. personnel voted in favour of a leaping kangaroo, seven per cent favoured an erect kangaroo and eight per cent wanted to retain the existing plain red spot in the centre of the roundel.

The leaping kangaroo was accordingly adopted officially.

By Comet to Woomera

IT is proposed to introduce de Havilland Comet 2s of Transport Command on a route between Britain and the weapons testing establishment at Woomera, Australia, early next year. No. 216 Sqn., at Lyneham, Wilts, who will operate the aircraft, have already begun training.

U.S.A.F. and St. Clement Danes

A BARBECUE and an air display were features which helped to attract some 90,000 people to the "autumn festival" at the U.S.A.F. base at Molesworth, Hunts, last weekend. The event was part of a widespread U.S.A.F. effort to raise 75,000 dollars (about £28,000) to buy an organ for the R.A.F. church of St. Clement Danes. This will form a memorial to U.S. airmen who lost their lives during World War 2 in the European fighting. Another fund-raising event will be the U.S.A.F. European football championship to be held at Wembley Stadium on December 1.

Silver Jubilee Gift

ON the occasion of No. 500 (County of Kent) Squadron's 25th anniversary dinner on October 27, Sir Roy Dobson, managing director of A. V. Roe and Co., Ltd., will present the squadron with a silver model of an Avro Anson. This gift commemorates the part played by the squadron with its 170 m.p.h. reconnaissance and escort Ansons during the Dunkirk retreat and the Battle of Britain, when they shot down six Messerschmitt 109s (top speed: 350 m.p.h.). This great achievement was partly due to the added potency of the Ansons, which carried an extra gun on either side of the fuselage (a feature which will also be included on the model).

The C.O. of the squadron at that time, S/L. W. K. Le May (now group captain and president of the squadron association), fitted a 20 mm Hispano cannon on a movable mounting on the floor, for use against E-boats.

This presentation by Avros is but one of many honours bestowed on No. 500 Sqn., who, as previously reported, has received the freedom of Maidstone and has been "adopted" by the town of Folkestone.

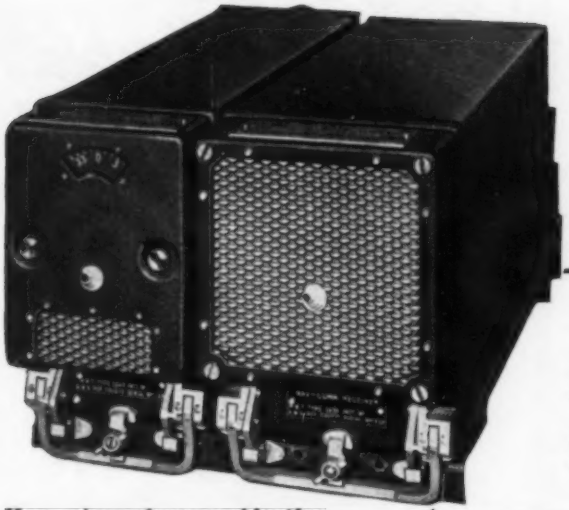
P.R. Trophy

THIS year, competition for the Sir Philip Sassoon Photographic Reconnaissance Trophy will, for the first time, take place among reconnaissance squadrons of 2nd A.T.A.F. The trophy was presented by Sir Philip in 1932 for competition among regular units of R.A.F. home commands engaged in air photographic duties. Since the war, when the award was suspended, it has been held by Bomber Command for competition among its P.R. squadrons. The present holders of the trophy are No. 540 (P.R.) Sqn. who won it in 1953 for the most accurate high-altitude photographic cover of selected targets. By transferring the award to 2nd A.T.A.F. it is hoped to increase the scope of the competition.

Minesweeping Exercise Ends

CLEAR passage for shipping was maintained throughout the NATO minesweeping exercise "Cut Loose," first announced on this page in our issue of September 21. Although under attack from air and sea, minesweepers cleared hundreds of mines to keep the routes open until the end of the exercise on October 11.

These CF-100 Mk 4s, for service with R.C.A.F. squadrons in Europe, are seen taking off from Avro's Malton airfield in their NATO camouflage finish.



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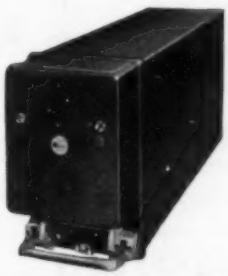

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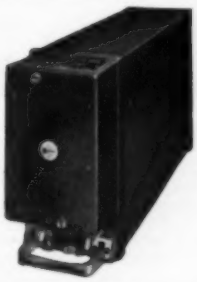

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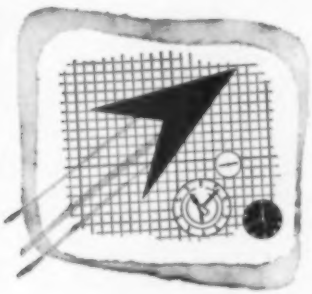

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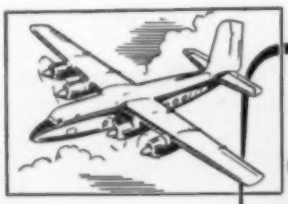

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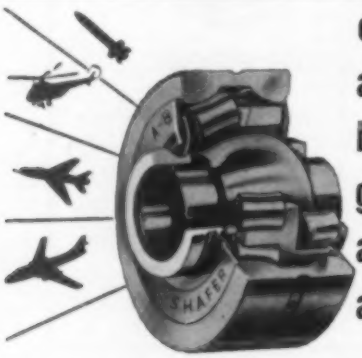

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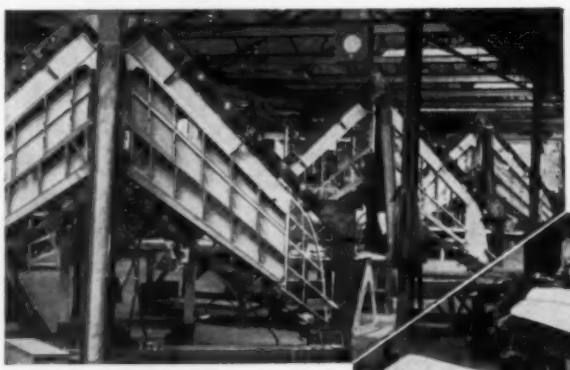

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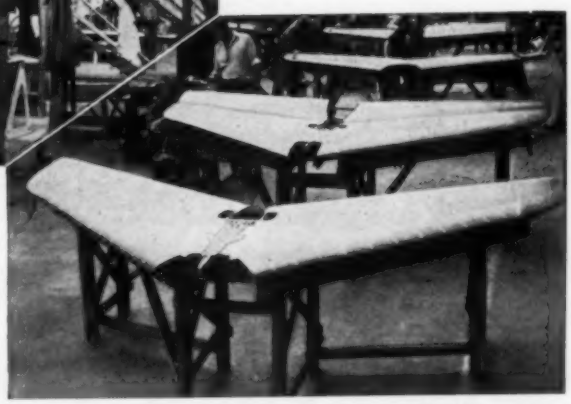

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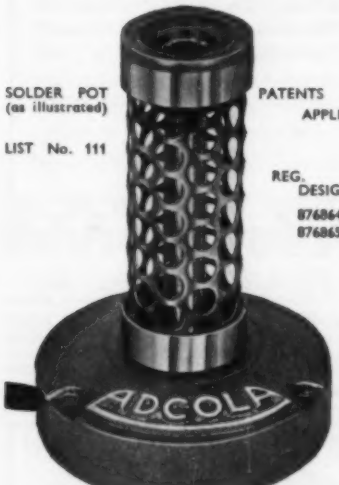

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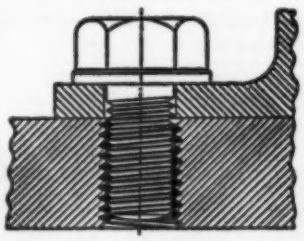

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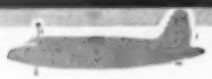

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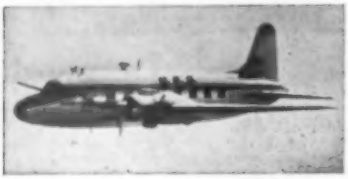

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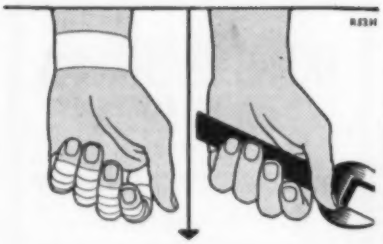

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PATENTS

THE Proprietor of British Patent No. 692,664 for "Improvement In or Relating To Helicopters," desires to enter into negotiations with a firm or firms for the sale of the patent, or for the grant of licences thereunder. Further particulars may be obtained from Marks and Clerk, 57 and 58, Lincoln's Inn Fields, London, W.C.2. [5817

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM Morton Air Services Ltd., of Croydon Airport, Croydon, Surrey, for the following Normal Scheduled Services with D.H. Dove aircraft and later possibly with D.H. Heron aircraft, for the carriage of passengers, supplementary freight and mail, for a period of seven years:—

APPLICATION No. 971. For a service between London (Croydon and/or Gatwick) and Paris (Le Bourget) with an intermediate traffic stop at Rotterdam at a frequency of from one to two services daily commencing from date of approval.

APPLICATION No. 972. For a service between London (Croydon and/or Gatwick) and Hamburg with an intermediate traffic stop at Rotterdam at a frequency of from one to two services daily commencing from date of approval.

APPLICATION No. 973. For a service between London (Croydon and/or Gatwick) and Frankfurt with an intermediate traffic stop at Rotterdam at a frequency of from one to two services daily commencing from date of approval.

APPLICATION No. 975. From Transair Ltd., of Croydon Airport, Croydon, Surrey, for a Normal Scheduled Service with Dakota aircraft and later possibly with Viscount 800 aircraft, for the carriage of passengers, supplementary freight and mail between London (Croydon and/or Gatwick) and Ibiza at a frequency of one service weekly increasing further according to traffic demand for a period of 10 years, commencing from date of approval.

APPLICATION No. 321/2. From Hunting-Clan Air Transport, Ltd., of London Airport, Hounslow, Middlesex, for continued approval of the Colonial Coach Service which they operate with Dakota and Viking aircraft for the carriage of passengers and supplementary freight between London Airport and Gibraltar, for a further period of seven years, commencing December 24, 1956, at an increased frequency of two services per week.

APPLICATION No. 976. From B.K.S. Air Transport Ltd., of 1, Marylebone High Street, London, W.1, for a Normal Scheduled Service with Dakota and Viking aircraft for the carriage of passengers, supplementary freight and mail between Belfast and Dublin at a frequency of three to seven return flights weekly increasing further according to traffic demand for a period of 10 years from the date of approval.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [5827

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FURTHER particulars for which early application is advised, from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting No. S.53/56 for Senior Scientific Officers and S.52/56 for Scientific Officers. [5822

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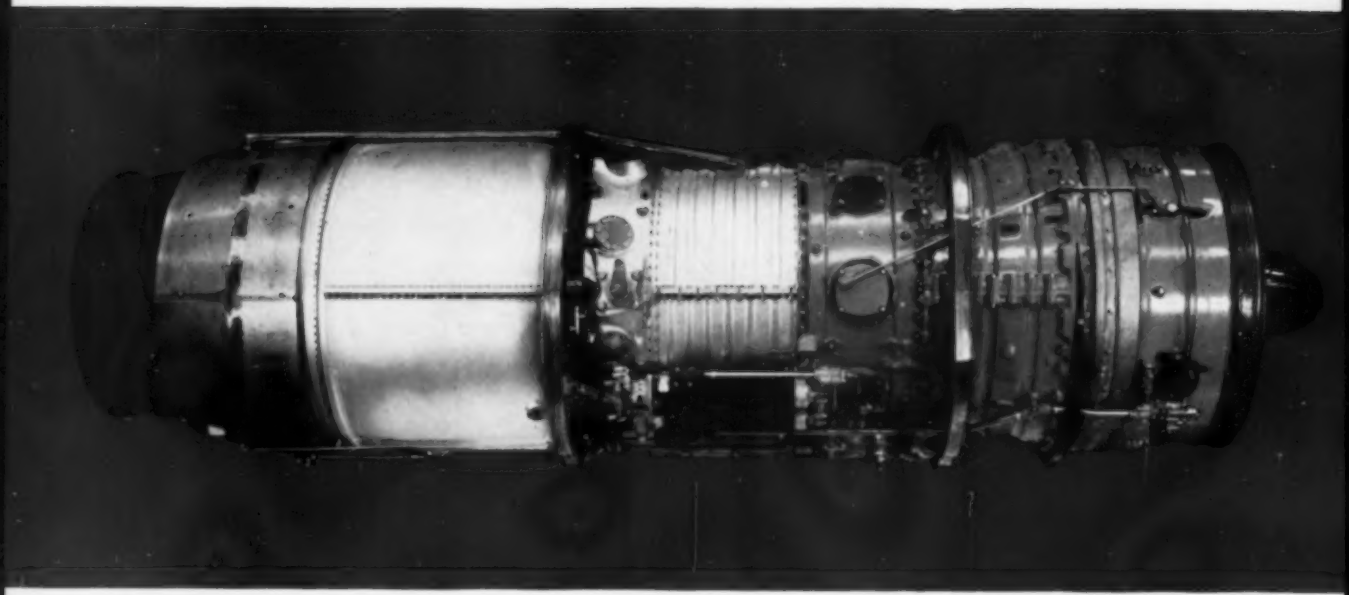

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